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CAR-LIGHTING ENGINEERS.

The first annual meeting of the Association of Car Lighting Engineers was held the best part of the week at the Grand Pacific Hotel, Chicago, and several thoroughly interesting and profitable sessions were participated in. On Wednesday evening the annual banquet was held, and on Friday the engineers made a visit of inspection to Milwaukee.

Two of the papers read at the opening session were particularly interesting. The first, by Mr. Patrick Kennedy, referred briefly to the general developments of car lighting by electricity, utilizing both the straight storage-battery equipment and combinations of axle-driven generators and other forms of installation. In the course of his paper Mr. Kennedy called attention to several absurdities upon which patents had been granted, and through which it was expected that the problem would be solved.

The other paper was by Mr. W. L. Bliss, and brought out with great clearness the innumerable difficulties under which the pioneers in this development have labored. Contrary to the present-day spirit of enterprise, there were not many railroad magnates in the old days who would consent to the spending of considerable sums of money for the trying-out of the various systems of car lighting. Mr. Bliss paid tribute, however, to several of those who, through their generosity and broadmindedness, had made possible the present-day developments.

While the advantage of using electric incandescent lamps for car lighting was recognized long ago, and installations made both here and abroad in the early eighties, the general tendency, except on a few of the larger roads, has been to get along in a loose fashion with any light which might be available and easily installed, placing the light units in a more or less haphazard fashion. The car-lighting engineer of today realizes that the comfort of the passenger will be greatly increased, and the value of the services of the engineers to their employers enhanced, if proper consideration is given to selecting the best types of equipment, as regards utility, reliability and accessibility, and distributing the light sources in the most scientific fashion.

Car-lighting engineering involves considerable detail of electrical ingenuity in construction and design, high mechanical ability in the same directions, and talent in the selection and placement of the lighting units. Today we call the latter feature illuminating engineering. So there is a possibility of combining the services of highly-trained men to work out the best system of power generation, and the best system of light distribution.

The electric train-lighting system today consists essentially of a dynamo either driven from the axle of the train by some

form of transmission, or operated by an auxiliary prime mover supplied with steam from the locomotive, a storage battery, a pole-changing device for taking care of the direction of running, an automatic switching contrivance for effecting the control of the battery, lamp and dynamo connections, and a regulating device for taking care of generator and lamp regulation.

The difficulties involved in axle-lighting in securing a direct and continuous drive have been almost insuperable. In most cases it is necessary to take the rough axle as it is received, equip it with a collar or hollow sleeve, and provide some form of elastic or telescopic transmission gearing between the driving axle and the pulley of the generator. The pounding and hammering to which the generator and the driving system are subjected make direct gearing almost impossible, and to secure a proper method of suspension the greatest effort has been made. The problem seems to have been best solved by the use of the rubber belt with a sufficiently large pulley ratio and wide enough pulley faces. Where the equipments are large enough to be built ruggedly and made a part of the locomotive, the problem of direct gearing is simplified. In the other case the belt forms a sort of mechanical safety fuse in the power-transmission system.

The equipment of railroad car-repair shops becomes a matter of importance in considering an axle-driven electric-lighting installation. Locomotive roundhouses are equipped with pits, which make the inspection of heavy generator cases an easy matter. Where the equipment which forms a part of the car is not placed in an easily accessible position, the labor of the repair man and the car-lighting engineer is greatly increased.

Pole-changers of every description, utilizing air, gas, gravity, mechanical movements, and others electrically operated, have been put forward for use in car lighting. The opinion seems today to favor the electrically-controlled pole-changer and brush-shifting mechanism. Some of the greatest difficulties encountered have been in effecting a proper relation between the dynamo and the discharged storage battery. To secure that regulation which will keep the battery properly charged and connect the dynamo while the train is running to either the lamp circuit or the battery circuit, as conditions may require, and which will automatically switch the battery onto the lamp circuit without prohibitive voltage fluctuations at the lamp terminals when the train is either running slow or standing still, has not been an easy task.

It is the opinion of Mr. Bliss that a great many of these problems have been, or are about to be, solved. The experience gained these many years has been profitably taken advantage of, and the men who have done the work are still available, so that it is easy to believe that they will see the consummation of their labors and enjoy the appreciation of perfected systems of train lighting in the very near future. To this end the association just organized can lend great help, and this is one of the fundamentals of the organization—to effect that uniformity of equipment and betterment of service which will put train lighting on the plane that has been reached in the best types of building illumination today.

MAINTAINING THE MAGNETITE ARC SYSTEM.

The extension of the magnetite arc lamps system in central-station street-lighting applications raises a number of special points in design and operation which are as yet not widely appreciated by power-plant attendants. The use of the constant-current transformer in conjunction with the mercury-arc rectifier presents some unusual problems in wiring, and there is here an excellent opportunity to employ the most advanced forms of iron conduit construction in planning the installation. In an ordinary 2,300-volt alternating-current plant both the constant-current transformer and the mercury-arc rectifier must come between the main station bus-bars and the arc-circuit distributing board. The first piece of apparatus obviously transforms constant potential into constant-current energy, while the mercury rectifier wipes out all the pulsations in one direction and delivers a direct current of constant amperage to the arc panels, since the latter is essential to the operation of the magnetite arc lamp under present commercial conditions. In the lay-out of such a system compactness in apparatus arrangement tends to bring the cost of wiring down, and if the equipment is not crowded, economy in first cost will be consistent with operating flexibility and ease of repairs.

In the actual operation of the system it is most important to keep the lines free from grounds, perhaps even more necessary than in the operation of an ordinary direct or alternating-current arc system. The reason for this is that the small current of four amperes used by the magnetite system at the lamps will not burn off incipient crosses as will the larger current of the older service. Hence a cross means that a circuit goes out of commission until it can be located and removed. Another point of importance is to keep the rectifier tubes from flashing. A flash amounts to an open circuit in this case, and produces a corresponding strain on the insulation of the lines and apparatus.

It is desirable to keep a careful record of the hours of service of each tube on a blank designed for the purpose. Each tube should be numbered, and in this way the life can readily be kept up to date. In some cases the tube life is now exceeding from 2,000 to 2,500 hours, which makes the cost very low at an initial investment of about $25 per tube. The ordinary magnetite arc lamp exhibits a high efficiency at the lamp, since four amperes at eighty volts are adequate for the service, but in order to check the performance of the system as a whole a recording wattmeter should be located just beyond the alternating-current bus-bars, where the initial circuits running to the tube transformers are tapped off. Instead of an average of 320 watts per arc, the total input per lamp at the 2,300-volt bus-bar is liable to be from 380 to 390 watts, representing a loss of about seventeen per cent in all the apparatus of the system. Considering the two current transformations this is not by any means a bad showing, and if the condition of the insulation and the flashing of the tubes are kept under close control, the results ought to be satisfactory in cases where this system seems to be the best for the local requirements.

MUNICIPAL LIGHTING IN CHICAGO.

At a recent meeting of the Chicago Electric Club, William Carroll, City Electrician of Chicago, made some interesting comparisons of the lighting of Chicago and other great cities in this country. Early in the year it was discovered that, as compared with New York, which contained 14,756 municipal arc lamps, Chicago had 8,822. The latter city had 3,000 less than Philadelphia, and a great many more than Cincinnati, Boston or St. Louis. The annual cost of municipal lighting in Chicago last year was $1,031,542; in New York, $2,648,546; in Philadelphia, $1,621,049, and in the other cities named considerably less. Only two of the cities—New York and Philadelphia—had a greater estimated candlepower than Chicago, and only one—New York—a greater area to be lighted.

It is interesting to note the development of the cost of municipal lighting. In 1895 it cost Chicago $1,098,000, in round numbers, for an estimated candlepower of 3,964,000. For the year 1907 the cost was $1,031,542, and the estimated candlepower 18,233,000.

Considerable improvement will be effected by changing over from the old steam stations to the new transformer substations, which will receive their primary source of current from the Drainage Canal system. The circuits which, under the old conditions, sometimes contained twenty-eight miles of wire, will also be materially shortened, the substations being established at natural centers of distribution.

It is estimated that in order to properly light the Chicago district at least 29,000 arc lamps will be needed. Assuming a cost of $115 per lamp, the total required would be nearly $2,000,000. Adding to this the cost of replacing the existing equipment, the cost would come to approximately $2,305,000.

Mr. Carroll and his predecessors have done the best possible with the facilities at hand, and the appropriations which have been available for municipal lighting. If there is to be adequate lighting in this great city, and if this result is to be accomplished quickly, the large amount of money necessary must be secured at one time, and can hardly come out of the general taxes. The adequate lighting of the city at the present day will certainly inure to the benefit of posterity, and it does not seem unreasonable that posterity should be saddled with some of the burden, and effectual means taken at once to secure, by bonds or otherwise, the wherewithal to effect this very necessary public improvement.

ELECTRIC HEATING.

The subject of electric heating has come to the fore of late years, and has attracted a good deal of discussion. Through the persistent efforts of a few hardy workers the possibilities of this method have been forced on the central stations and the manufacturers, and today we are more or less familiar with a number of contrivances for utilizing electricity as an agent for producing heat in domestic and industrial operations.

At the meeting of the American Institute of Electrical Engineers last week, Mr. W. S. Hadaway, Jr., presented a paper entitled "Electric Heating," which, in a most conservative fashion, pointed out some of the limitations and advantages of heating by electricity. It appears that for industrial operations where a high heat and localized application are desirable, there is nothing so economical as the electric heating device, leaving out of consideration the concomitant advantages of cleanliness, convenience and better hygienic conditions. In the larger applications, such as heating large rooms, it would appear that electricity is a rather poor competitor of low-pressure steam, especially where steam is readily available. On the other hand, there are those exponents of electric heating for both domestic and industrial applications who do not hesitate to say that the apparatus for converting electrical energy into heat is available, and all that is needed to make it highly popular and strictly essential is a cheapening of the cost of production. In competition with electricity the price of gas has been brought to a pretty low level, and the possibility exists that as competition continues, and as the materials of construction are more conservatively handled and the cost of production is reduced, electricity will become cheaper at a greater rate than gas. The possibility of utilizing large waterpowers, thus securing low power costs, with the probability of the raw material from which gaseous and solid fuel is converted increasing in value, heightens the likelihood of electricity taking first place as a heating agent.

THE ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

On other pages of this issue there appears an illustrated description of the features of the electrification of the tunnel under the St. Clair River, operated by the Grand Trunk system between Port Huron, Mich., and Sarnia, Ontario. From portal to portal the tunnel is 6,032 feet in length, and the electrification has been carried out under the direction of the engineers of the company, with Bion J. Arnold acting in a consulting capacity.

Several interesting features in electrical and mechanical design have been worked out in order to make expedient the handling of trains through this tunnel under rather difficult conditions. As is well known, the electrical system of propulsion is supplied by alternating current at twenty-five cycles and 3,300 volts, the current being stepped down by means of ventilated transformers carried on the locomotives to 235 volts for use by the motors. The power station is built on the Port Huron bank of the St. Clair River, almost directly over the tunnel, and the feeders are led to the tunnel by means of a shaft intake extending vertically from the power house.

One of the striking features in the equipping of the generating system is the installation of an automatic system for controlling combustion, to anticipate the demands for increased power when the trains are running through the tunnels and climbing the steep ascents. By means of under-feed stokers and throttling devices the demand for power is anticipated, and a throttling device on the steam supply to the fan engine increases the boiler capacity automatically. As the pressure reestablishes itself and tends to rise above normal, the supply of steam to the fan engine is diminished, bringing about equilibrium of service.

Final Report International Conference on Electrical Units and Standards.

The sessions of the International Conference on Electrical Units and Standards were concluded on October 22. A progress report of the meetings, and including a preliminary draft of the specifications relating to mercury resistance standards, deposition of silver, and to the Weston normal cell, was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of November 7. The final report adopted by the Conference is as follows in full:

The Conference on Electrical Units and Standards, for which invitations were issued by the British government, was opened by the president of the Board of Trade, the Right Hon. Winston S. Churchill, M. P., on Monday, October 12, 1908, at Burlington House, London, S. W. Delegates were present from twenty-one countries, and also from the following British dependencies, namely, Australia, Canada, India and the Crown Colonies. It was decided by the conference that a vote each should be allowed to Australia, Canada and India, but a vote was not claimed or allowed to the Crown Colonies. The total number of delegates to the conference was forty-three, and their names are set out in Schedule A appended to this report.

The officers of the conference were: President, the Right Hon. Lord Rayleigh, O. M., president of the Royal Society; vice-presidents, Prof. S. A. Arrhenius, Dr. M. Egoroff, Dr. Viktor Edler von Lang, M. Lippmann, Dr. S. W. Stratton, Dr. E. Warburg; secretaries, Mr. M. J. Collins, Mr. W. Duddell, F. R. S., Mr. C. W. S. Crawley, Mr. F. Smith.

The conference elected a technical committee to draft specifications and to consider any matter which might be referred to the committee and to report to the Conference. The Conference and its technical committee each held five sittings. As a result of its deliberation the Conference adopted the resolutions and specifications attached to this report and set out in Schedule B, and requested the delegates to lay them before their respective governments with a view to obtaining uniformity in the legislation with regard to electrical units and standards.

The Conference recommends the use of the Weston normal cell as a convenient method of measuring both electromotive force and current when set up under the conditions specified in Schedule C.

In cases in which it is not desired to set up the standards provided in the resolutions, Schedule B, the Conference recommends the following as working methods for the realization of the international ohm, the ampere and the volt:

1. For the International Ohm.

The use of copies, constructed of suitable material and of suitable form and verified from time to time, of the international ohm, its multiples and submultiples.

2. For the International Ampere.

(a) The measurement of current by the aid of a current balance standardized by comparison with a silver voltameter;

(b) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

3. For the International Volt.

(a) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or

(b) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

The duty of specifying more particularly the conditions under which these methods are to be applied has been assigned to the Permanent Commission, and pending its appointment, to the scientific committee to be nominated by the president (see Schedule D), who will issue a series of notes as appendix to this report.

The Conference has considered the methods that should be recommended to the governments for securing uniform administration in relation to electrical units and standards, and expresses the opinion that the best method of securing uniformity for the future would be by the establishment of an international electrical laboratory with the duties of keeping and maintaining international electrical standards. This laboratory to be equipped entirely independently of any national laboratory.

The Conference further recommends that action be taken in accordance with the scheme set out in Schedule D.

SCHEDULE A—LIST OF COUNTRIES AND DELEGATES.

America (United States).—Dr. S. W. Stratton, Dr. Henry S. Carhart, Dr. E. B. Rosa.

Austria.—Dr. Viktor Edler von Lang; Dr. Ludwig Kusminsky.

Belgium.—Prof. Eric Gérard, M. Clement.

Brazil.—Mr. L. Weiss.

Chile.—Don Victor Eastman.

Colombia.—Don Jorge Roa.

Denmark and Sweden—Prof. S. A. Arrhenius.

Ecuador.—Sr. Don Celso Nevares.

France.—Prof. Lippmann, M. R. Benoit, M. de Nerville.

Germany.—Prof. Warburg, Prof. Jaeger, Prof. Lindeck.

Great Britain.—The Right Hon. Lord Rayleigh (president), Prof. J. J. Thomson, Sir John Gavey, Dr. R. T. Glazebrook, Major W. A. J. O'Meara, Mr. A. P. Trotter.

Guatemala.—Dr. Francisco de Arce.

Hungary.—Joseph Váter, Dr. Desiré Harsanyi.

Italy.—Prof. Antonio Rôiti.

Japan.—Dr. Osuke Asano, Mr. Shigeru Kondo.

Mexico.—Don Alfonso Castelló, Don José Maria Perez.

Netherlands.—Dr. H. Haga.

Paraguay.—M. Maximo Croskey.

Russia.—Dr. N. Egoroff, Col. L. Swentorzetzky.

Spain.—Don José Maria Madariaga, Don A. Montenegro.

Switzerland.—Dr. Fr. Weber, Dr. Pierre Chappuis, Dr. J. Landry.

Australia.—Mr. Cecil W. Darley, Prof. Threlfall.

Canada.—Mr. Ormond Higman.

Crown Colonies.—Major P. Cardew.

India.—Mr. M. G. Simpson.

SCHEDULE B—RESOLUTIONS.

1. The Conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimetre as the unit of length, the gramme as the unit of mass and the second as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimetre and second; (2) the ampere, the unit of electric current which has the value of one-tenth (0.1) in terms of the centimetre, gramme and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimetre, the gramme and the second; (4) the watt, the unit of power which has the value of 10,000,000 in terms of the centimetre, the gramme and the second.

2. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the Conference recommends the adoption of the international ohm, the international ampere and the international volt defined according to the following definitions:

3. The ohm is the first primary unit.

4. The international ohm is defined as the resistance of a specified column of mercury.

5. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross-sectional area and of a length of 106.300 centimetres.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in specification 1 attached to these resolutions.

6. The ampere is the second primary unit.

7. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the specification 2 attached to these resolutions, deposits silver at the rate of 0.00111800 of a gramme per second.

8. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

9. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

SPECIFICATION 1.

SPECIFICATION RELATING TO MERCURY STANDARDS OF RESISTANCE.

The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimetre. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore not being exactly the same at all parts of the tube must not exceed five parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0°C. as possible. The measurements are to be corrected to 0°C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately four centimetres), and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact

with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula—

$$A = \frac{0.80}{1{,}063\,\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)\text{ohm},$$

where r_1 and r_2 are the radii in millimetres of the end sections of the bore of the tube.

The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

SPECIFICATION 2.

SPECIFICATION RELATING TO THE DEPOSITION OF SILVER.

The electrolyte shall consist of a solution of from fifteen to twenty parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than thirty per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed one-fifth ampere per square centimetre and at the cathode one-fiftieth ampere per square centimetre.

Not less than 100 cubic centimetres of electrolyte shall be used in a voltameter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode.

Before weighing, any traces of solution adhering to the cathode must be removed and the cathode dried.

SCHEDULE C.—WESTON NORMAL CELL.

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of electromotive force and of current, and when set up in accordance with the following specification may be taken, provisionally,* as having, at a temperature of 20°C., an electromotive force of 1.0184 volts.

SPECIFICATION RELATING TO THE WESTON NORMAL CELL.

The Weston normal cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8/3 H_2O) as its electrolyte.

The electrolyte must be neutral to Congo red.

The positive electrode is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by weight of cadmium in 100 parts of amalgam.

The depolarizer, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate.

*See duties of the Scientific Committee, Schedule D.

The different methods of preparing the mercurous sulphate paste are described in the notes.¶ One of the methods there specified must be carried out.

For setting up the cell the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolarizer is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

The following formula is recommended for the electromotive force of the cell in terms of the temperature between the limits 0° C. and 40° C.:

$$E_t = E_{20} - 0.0000406\,(t-20°) - 0.00000095\,(t-20°)^2 + 0.00000001\,(t-20)^3.$$

SCHEDULE D.

1. The Conference recommends that the various Governments interested establish a permanent International Commission for Electrical Standards.

2. Pending the appointment of the Permanent International Commission, the Conference recommends (*) that the president, Lord Rayleigh, nominate for appointment by the Conference a scientific committee of fifteen to advise as to the organization of the Permanent Commission, to formulate a plan for and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values (†), intercomparison of standards and to complete the work of the Conference (‡). Vacancies on the committee to be filled by co-optation.

3. That the laboratories equipped with facilities for precise electrical measurements and investigations should be asked to co-operate with this committee and to carry out, if possible, such work as it may desire.

4. The committee should take the proper steps forthwith for establishing the Permanent Commission, and is empowered to arrange for the meeting of the next Conference on Electrical Units and Standards, and the time and place of such meeting should this action appear to them to be desirable.

5. The committee or the Permanent International Commission shall consider the question of enlarging the functions of the International Conference on Weights and Measures with a view to determining if it is possible or desirable to combine future Conferences on Electrical Units and Standards with the International Conference on Weights and Measures, in place of holding in the future conferences on electrical units and standards. At the same time it is the opinion of the Conference that the Permanent Commission should be retained as a distinct body, which should meet at different places in succession.

¶Notes on methods pursued at various standardizing laboratories will be issued by the Scientific Committee or the Permanent Commission, as an appendix to this report.

*In accordance with the above, Lord Rayleigh has nominated the following committee, which has been approved by the Conference, viz.: Dr. Osuke Asano, M. R. Benoit, Dr. M. N. Egoroff, Prof. Eric Gérard, Dr. R. T. Glazebrook, Dr. H. Haga, Dr. L. Kusminsky, Prof. G. Lippmann, Prof. A. Ròiti, Dr. E. B. Rosa, Dr. S. W. Stratton, Mr. A. P. Trotter, Prof. E. Warburg, Prof. Fr. Weber, Professor Lindeck.

†This will include the reconsideration from time to time of the electromotive force of the Weston normal cell.

‡With this object the committee is authorized to issue as an appendix to the report of the Conference notes detailing the methods which have been adopted in the standardizing laboratories of the various countries to realize the international ohm and the international ampere, and to set up the Weston normal cell.

Annual Report of Cornell University.

In the annual report of Jacob Gould Schurman, president of Cornell University, which was presented to the Board of Trustees on November 7, the following figures were shown:

There were 4,465 students enrolled for the year ended September, 1908. Of these, 3,734 were regularly enrolled students during the academic year from September to June, and the others were attendants at the summer session and the winter school in agriculture. This is an increase of 240 over the enrollment for the preceding year.

The number of members of the instructing staff is given as 548, excluding the members of the staff of the Medical College, in New York. The faculty at Ithaca is made up as follows: Seventy-five professors, sixty-four assistant professors, six lecturers, 122 instructors and 144 assistants.

New courses have been added to the curriculum in the College of Engineering, notably in the field of sanitary engineering. President Schurman points out that there is little necessity for improvement in the field of hydraulics.

Excluding the Medical College in New York city, which is maintained by separate funds, the productive funds of the university amounted, on August 1, 1908, to $8,628,370.31. The inventoried value of the grounds and buildings was given as $4,263,405.07. The income statement shows a total income from all sources of $1,356,498.59, running short of the expense budget by $12,242, as a result of the purchase of campus lands.

New York Rapid Transit Investigation.

J. Edward Simmons, president of the New York Chamber of Commerce, has appointed Eugenius H. Outerbridge, Paul M. Warburg, Howard C. Smith, Clarence H. Kelsey and Marcellus Hartley Dodge as a special committee of five to investigate the conditions now surrounding the question of the construction of further rapid-transit lines in New York city.

This committee was appointed under a resolution submitted at the last meeting of the Chamber by President Hepburn, of the Chase National Bank. This resolution declared that the present rapid-transit facilities of the city are insufficient and that the construction of additional lines is delayed and obstructed by causes that should be clearly established in order that they may be removed.

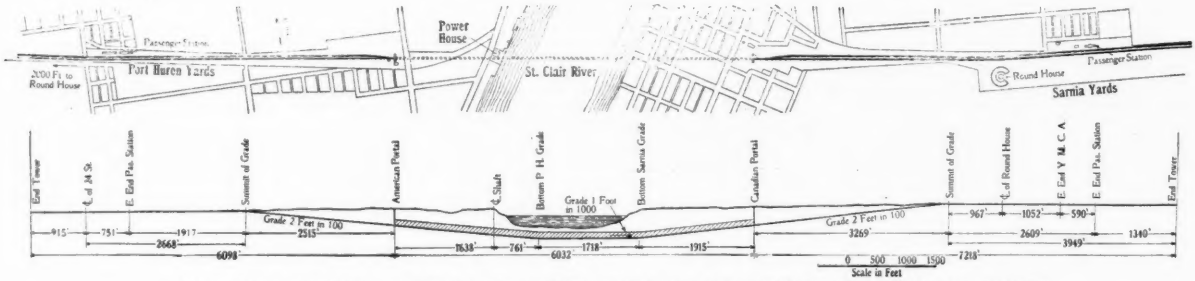
The Electrification of the St. Clair Tunnel.

Formal Taking Over by the Grand Trunk on November 12 of Its International Submarine Tunnel between Sarnia, Ont., and Port Huron, Mich.

BY O. H. CALDWELL.

The electrification of the St. Clair Tunnel was formally declared complete and its operation by single-phase, alternating-current locomotives taken over by the Grand Trunk Railway on Thursday, November 12, when an inspection party of over one hundred persons, comprising officials of the Grand Trunk and other railroads, engineers, and representatives of the technical and public press, visited the tunnel, pump houses and power plant, and celebrated the electrification event with an international luncheon at Sarnia, tendered by the railroad company. The St. Clair Tunnel under the St. Clair River, near the cities of Port Huron, Mich., and Sarnia, Ontario, linking the 10,000 miles of track of the Grand Trunk system, although finished in 1890 is the longest submarine tunnel in the world. The interest of the formal occasion last week marking the change to an improved motive power was heightened by the presence of the now venerable engineer who carried through the tunnel construction almost a score of years ago, as well as the engineers who have multiplied the capacity of the tunnel and insured the safety and comfort of its passengers.

Preliminary work on the St. Clair Tunnel was begun in 1886, and after several unsuccessful efforts the present shield system was finally adopted and the tube was opened for traffic in 1890. From portal to portal the tunnel length is 6,032 feet, the bore being approached by open-cut inclines on the American and Canadian sides of respectively 2,500 and 3,300 feet in length, making the total distance between the American and Canadian summits over two miles. As shown in the accompanying plan and profile, the grade on the approaches and inclined sections of the tunnel is two per cent, while the flat middle section, 1,700 feet in length, has a slight grade toward the Canadian end sufficient to provide for collecting condensation and seepage water. A single track extends through the tunnel, connecting with a double track on both approaches. The tunnel shell proper is nineteen feet in diameter and is made up of sectional cast-iron rings. The total original cost of the tunnel, including machinery and equipment, was $2,700,000.

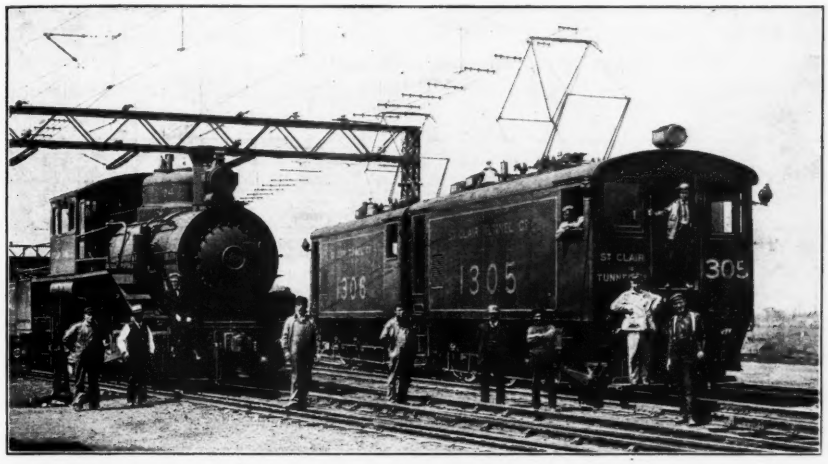


MAP AND PROFILE OF THE ST. CLAIR TUNNEL AND ADJACENT RAILROAD YARDS.

The tunnel service is operated by the St. Clair Tunnel Company, a subsidiary of the Grand Trunk Railway system, which takes the trains from the eastern division at the Sarnia yards and delivers them to the western division at the Port Huron yards, and vice versa. For this service four steam locomotives especially designed to exert a large drawbar pull and to burn anthracite coal in order to avoid smoke, were provided to operate the trains over the heavy grades in the tunnel and on the approaches. As the traffic on the road increased, these facilities were found to be inadequate to cope with the car movement, for the maximum weight of the trains handled was limited to about 760 tons, and even with this load the speed on the ascent was often very slow.

ELECTRIC LOCOMOTIVE IN THE ST. CLAIR TUNNEL, SHOWING THE INTERSECTION OF THE VERTICAL SHAFT THROUGH WHICH ARE BROUGHT THE FEEDERS FROM THE POWER HOUSE.

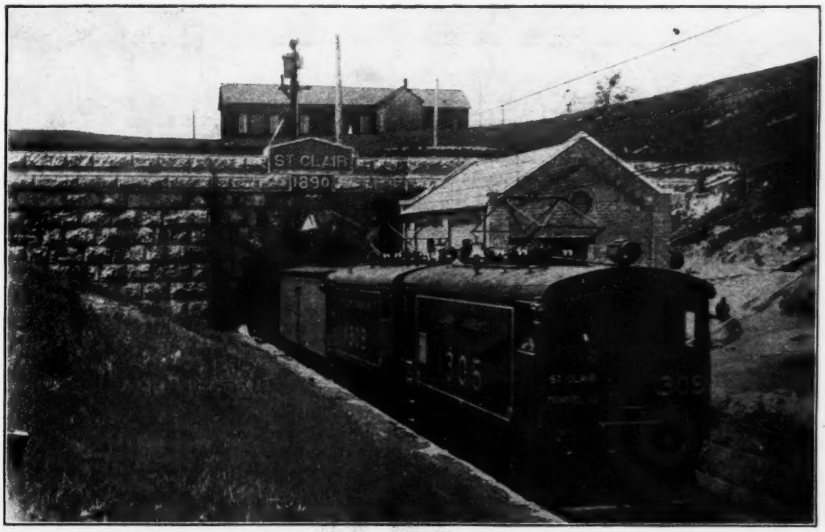
The element of danger was always present in the St. Clair Tunnel under steam operation on account of the poisonous gases given out by the locomotives, and several serious accidents occurred before the electrification was made. Under the former conditions it was considered inadvisable to use air brakes on freight trains during the run through the tunnel on account of the danger of the train breaking in two, which would result in setting the air brakes. In such a case before the engine crew could return and make the necessary hose coupling the tunnel would become dangerously filled with gases.



COMPLETE ELECTRIC LOCOMOTIVE, AND SPECIAL ANTHRACITE-BURNING ENGINE FORMERLY USED TO HAUL TRAINS THROUGH ST. CLAIR TUNNEL.

different systems of electrical operation were thoroughly considered and complete estimates were made covering the alternating-current and direct-current systems, the latter both with and without storage batteries. The final decision favored twenty-five-cycle alternating current with a 3,300-volt single-phase supply for the locomotives, using a steam boiler expedient to supply the characteristic of a storage battery in the direct-current system. It is a notable fact that this was the first single-phase installation on so large a scale planned in this country.

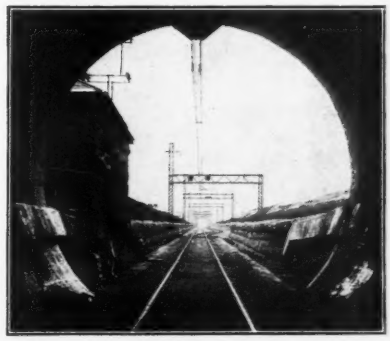
According to the specifications required of the contractor the installation must be capable of hauling a 1,000-ton train through the tunnel from terminal to terminal in fifteen minutes at a speed not exceeding a maximum of twenty-five miles per hour, and at not less than a minimum speed of ten miles per hour ascending the grade. The locomotives were specified to be of sufficient capacity to develop a drawbar pull of 50,000 pounds at the operating speed of ten miles per hour. This would permit of the transfer of four trains per hour between Sarnia and Port Huron, which is about three times the capacity at present required by traffic conditions.



ELECTRICALLY-DRAWN FREIGHT TRAIN EMERGING FROM THE CANADIAN PORTAL. PUMP HOUSE AT RIGHT OF ENTRANCE.

With these serious disadvantages of the existing steam operation in view the Grand Trunk Railway officials took up the consideration of electrifying the St. Clair Tunnel, and Bion J. Arnold was called into conference as consulting electrical engineer. The advantages of the

The single-phase, twenty-five-cycle alternating-current system for the locomotives has been installed in the yards and through the tunnel. Single-catenary construction is used, the messenger cable of galvanized steel being suspended from insulators on overhead bridges 250 feet apart, and from this cable the working conductor is supported by rods of varying lengths designed to give it a uniform height above the rail of twenty-two feet. In the yards No. 0000 groved copper is used, while on the tunnel approach and in the tunnel are carried two 300,000-circular-mil conductors. The messenger cables of the outside catenary construction terminates in heavy anchors in the masonry portals, and in the tunnel the working conductor is carried by special brackets, being held nine inches from the tunnel shell. The two messenger cables are supported on barrel-type insulators spaced at 12-foot intervals. The messengers carry special spiders which support the working conductors. These spider supports are not located in the center, but at a point three feet from the middle of the messenger span, as sufficient resiliency of the working conductor is obtained by this construction. The clearance between the messenger cables and the tunnel shell is three inches, and as the trolley wires are suspended six inches below the messengers, the height of the working conductor is fifteen feet five inches above the track rail.

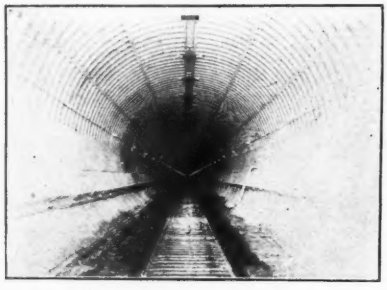


THE APPROACH TO THE AMERICAN SUMMIT AT PORT HURON.

The St. Clair locomotives are of the rigid-frame type, having three pairs of

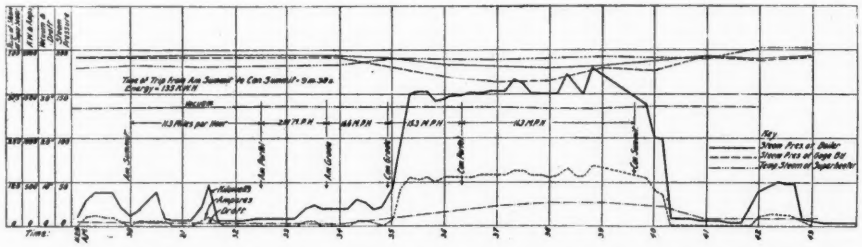
drivers, each axle connected through gears to 250-horsepower, single-phase railway motors. The locomotives weigh sixty-six tons each, and being provided with multiple-unit control, are generally used in pairs. Such a combination of two locomotives was designed to draw a 1,000-ton train through the tunnel and up the two per cent grade, on the latter involving a drawbar pull of 50,000 pounds. The locomotives were further required to start from standstill such a train up the grade and accelerate it to the normal speed of eleven miles per hour. The maximum speed of the locomotives is thirty miles per hour, then exerting a tractive effort of 6,000 pounds.

The trolley-wire pressure of 3,300 volts is stepped down by means of the main transformer, carried on the locomotive, to 235 volts. Control of the motor speed during acceleration and running is effected by bringing out taps from the transformer, thus applying any desired



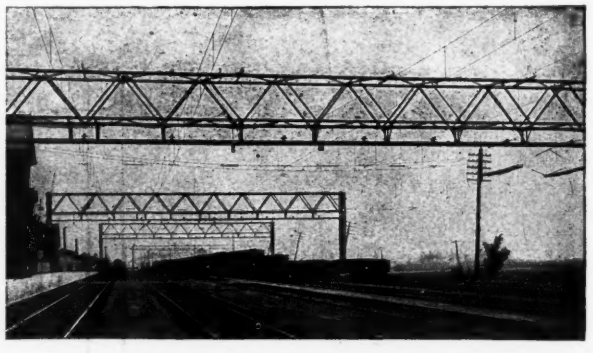
INTERIOR VIEW OF THE ELECTRIFIED ST. CLAIR TUNNEL.

graduated voltage to the motors. The master controller handled by the motorman operates pneumatic valves by means of solenoids deriving current from a twenty-four-volt storage battery. These electro-pneumatic valves in turn control the compressed-air plungers which operate the working contacts. Other operations in the locomotive cab, such as ringing the bell, sanding the tracks, and raising and depressing the pantagraph trolley, are performed pneumatically from push-buttons under the motorman's hand. The main auto-transformer is connected to the trolley through a circuit-breaker provided with a no-voltage release, so that if the car wheels should leave the track, the trolley remaining in contact with the wire, the circuit-breaker automatically opens, thus obviating any possible accident from the trolley voltage charging the ungrounded car. A single-phase motor drives the blower which delivers air to both the transformer and motors, the cooling action being so effective that when operating at full capacity the transformer and motor temperatures are comparatively little above that of the surrounding air. The heated air coming from the transformers may be passed up through the cab for heating purposes, if desired, although other standard electrical heaters are provided. The motor-driven air compressors located in the cab are of the standard type, and, like the blower motor, are supplied by a 100-volt



LOG CURVE OF POWER PLANT OPERATION DURING A TYPICAL RUN THROUGH TUNNEL.

tap from the main transformer. Air from the compressor supplies the straight and automatic air brakes, operates the electro-pneumatic switches and is used for the variety of other minor uses described. Important in operation up the grade in the tunnel and for starting a train of mixed rolling stock, is the gradual acceleration possible with these electric locomotives which are supplied with twenty-one control points, seventeen of which are running positions. A very



OVERHEAD SINGLE-CATENARY 3,300-VOLT TROLLEY CONSTRUCTION IN PORT HURON YARDS.

marked decrease in the number of train breaks-in-two has resulted with the use of these machines.

A half-unit locomotive has been tested with a dynamometer car to show a drawbar pull of 43,000 pounds before slipping the wheels on a sanded track, and on this basis, a drawbar pull of 86,000 pounds might be considered possible with a complete locomotive. The locomotives are operated equally well from either end of the cab, all controlling apparatus being duplicated. Speed indicators mounted in front of the engine-driver's seat show the speed at which the locomotive is running and provide a record for the trip. Other apparatus forming the equipment of each locomotive are the necessary ammeters, voltmeters, wattmeters, preventive resistance coils, circuit-breaker and storage battery for operating the pneumatic valves. Provision is made for charging the battery by means of a small 100-watt motor-generator set. The pantagraph trolley is of the usual standard construction. The bow presses upward on the conductor with a force of from seven to eight pounds. The following general dimensions of a single half-unit are given by the manufacturer:

Length over all, 23 feet 6 inches; height from top of rail to top of roof, 13 feet; height from top of rail to top of pantagraph bow when lowered, 14 feet 11 inches; width of cab over all, 9 feet 8 inches; total weight of locomotive half-unit, fully equipped, 67½ tons (this weight is practically evenly divided over three drivers); weight of complete locomotive unit, 135 tons; length of rigid wheel base, 16 feet; diameter of driving wheels, 62 inches.

In service it has been found that the locomotives will readily handle a 1,000-ton train at a speed of even fourteen miles per hour up the two-per-cent grade, and since May 17 of this year the elec-

trical equipment has been in continual service, handling the entire freight and passenger traffic of the St. Clair Tunnel Company, over whose tunnel single track is concentrated, of course, all the business of the Grand Trunk Railway at this point. A log sheet showing train-operation characteristics of a typical run is reproduced on the opposite page.

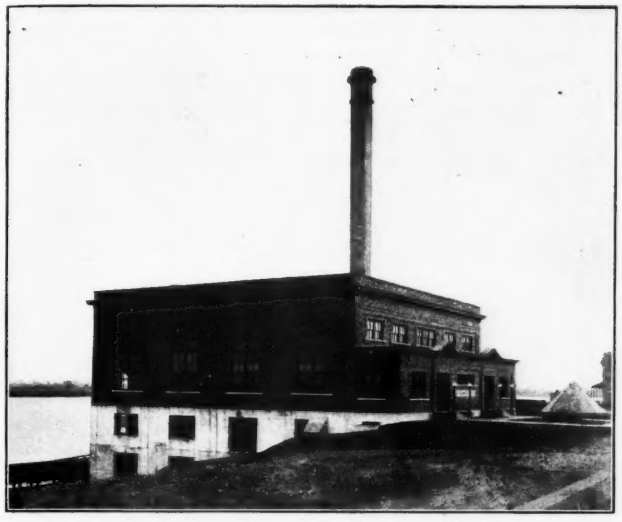
As the result of the electrification the tunnel is now a clean, white gallery, filled with pure, cool air, and the trip from portal to portal is made in a few minutes without any discomfort to passengers.

The conditions which have to be met by the power plant are unusual, entailing severe peak-loads during the passage and particularly the ascent of the tunnel trains, with long and irregular intermissions of comparatively small power output. The service provided by the power house involves, besides the propulsion of the trains through the tunnel, the operation of pumps when necessary for clearing the tube of drainage and seepage water, and a small lighting load in the yards, stations and adjacent buildings.

The power plant, shown herewith, is located on the Port Huron bank of the St. Clair River at a point almost directly over the tunnel. A vertical shaft extending down to the tunnel which carries the feeders for the trolley, power and lighting circuits, emerges about seventy-five feet from the wall of the building, its upper end being indicated by the pyramidal roof seen in the illustration. The lower end of this shaft is shown in another illustration, where the feeder conduits are seen entering the tunnel tube, passing down the walls and leading into the ducts.

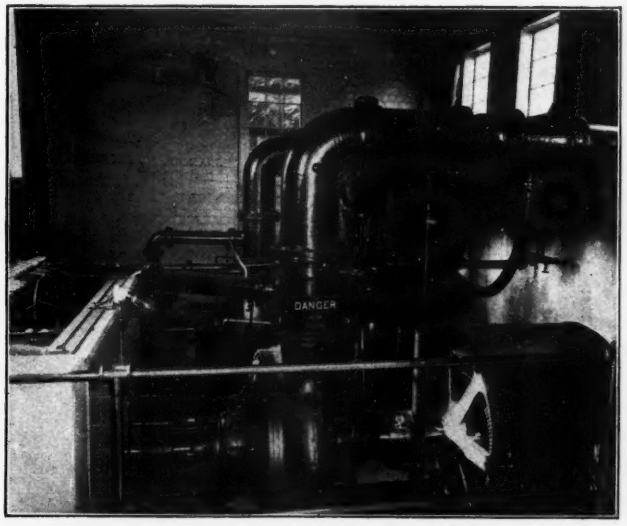
The power-house building covers a ground area of 10,000 square feet and is divided longitudinally by a heavy fire-wall which separates the boiler from the turbine rooms. The building is a dignified but ornate structure of steel and brick, and presents an attractive appearance.

Coal is delivered to the plant over a wooden trestle leading above the receiver hopper which feeds directly into the crusher. The latter has a capacity of about thirty tons per hour, and also acts as a feeder, delivering the coal at a uniform rate to the vertical bucket-elevator extending to the top of the building. From the elevator the coal is dropped onto a conveyor belt, from which it is

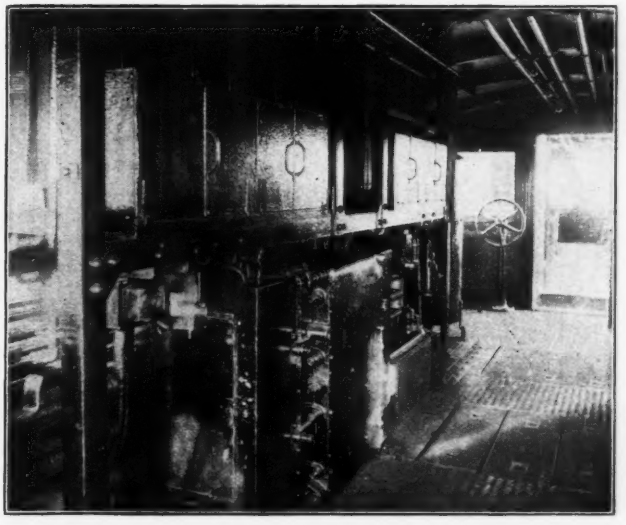


THE POWER HOUSE ON THE AMERICAN SHORE. THE CONICAL ROOF CAPPING THE VERTICAL CONDUIT SHAFT IS SEEN AT THE RIGHT.

VIEW OF THE TURBINE-ROOM FLOOR OF THE POWER HOUSE, SHOWING EXCITERS, TURBO-GENERATORS, CONDENSERS, GAUGE BOARD AND PUMPS.



A PUMP HOUSE INTERIOR, SHOWING CENTRIFUGAL PUMPS DRIVEN BY 3,300-VOLT INDUCTION MOTORS.



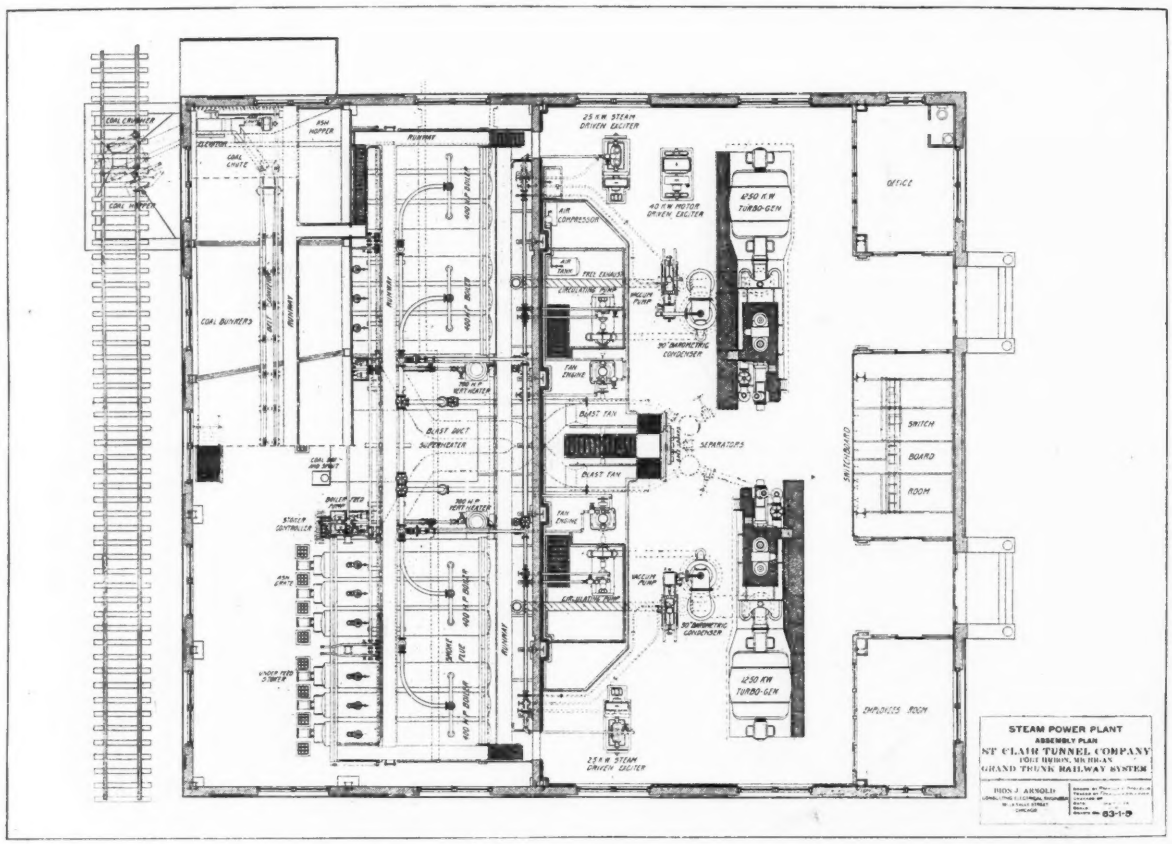
INTERIOR VIEW OF A LOCOMOTIVE. HALF-UNIT, SHOWING TRANSFORMING EQUIPMENT.

discharged into the bunkers. A twenty-horsepower, slow-speed induction motor drives the crusher, and a similar ten-horsepower motor operates the elevator and conveyor. The coal bunkers are of reinforced concrete, resting on the structural steelwork of the building, and the space occupied by the buukers, crusher pit and elevator machinery is completely enclosed by a metal partition to obviate the penetration of coal-dust into the boiler room and other parts of the building.

The expedient by which is effected an available reserve of power, amounting in effect to the automatic characteristics of a storage-battery installation, has been worked out with great nicety and ingenuity. By means of the Jones underfeed stoker equipment, the combustion under the furnaces is controlled automatically so as to be proportionate to the draft for power on the station. By means of the regulating mechanism, a part of which is shown near the center of the illustration of the boiler room, both the air supply and the rate of feeding the coal into the boiler furnaces is controlled. This regulation is accomplished by a Skitts regulating valve, which throttles the steam supply to the fan engines, at the same time controlling the rate of stoking through a Cole automatic regulator which is driven from the shaft of the fan engines. Thus when the boiler pressure has re-established itself and tends to rise above normal, the supply of steam to the fan engine is decreased, diminishing the supply of air and the rate of stoking coal to the furnaces.

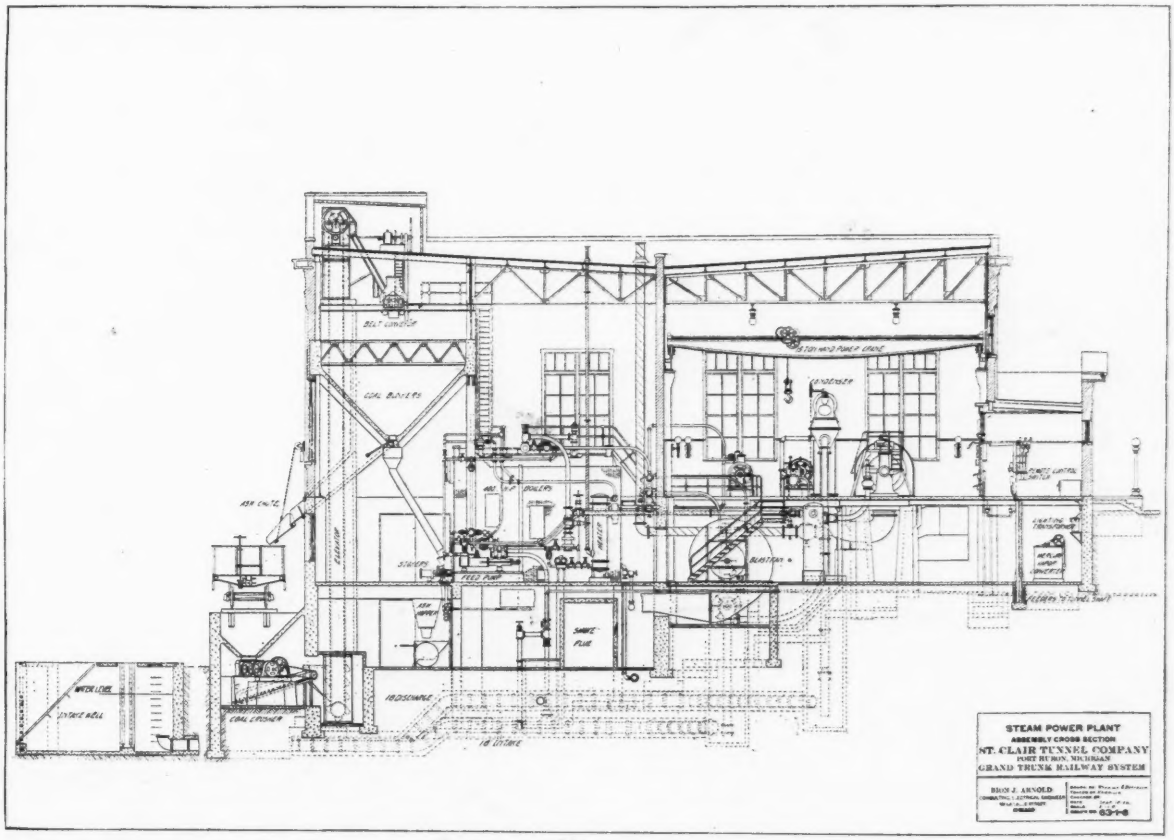
The boiler equipment consists of four 400-horsepower Babcock & Wilcox sectional water-tube boilers arranged in two batteries. These boilers are unusually wide, having the tubes arranged nine high and twenty-one wide, in order to secure quick steaming. Each boiler has three drums forty-two inches in diameter and twenty-three feet four inches in length. The drums thus provide a storage for a large quantity of heated water which becomes available as steam upon a decrease of pressure. The boilers are designed to carry 200 pounds pressure, and are equipped with tandem-connected Morris blow-off valves and the usual pressure and water gauges and check valves. Between the two batteries of boilers is seen the separately-fired Foster superheater, which was furnished by the Power Specialty Company. This superheater has a capacity to add 200 degrees superheat to 36,000 pounds of steam per hour. The superheater is hand-fired, but has an automatic temperature regulator for admitting air either above or below the fires, thus controlling the superheat within thirty degrees. A thermal coupling placed in the superheater steam outlet operates through a relay and solenoid, on the valve of a hydraulic cylinder, which controls the dampers in the air supply.

The alternating-current generating equipment consists of two Westinghouse-Parsons turbo-generators operating at 1,500 revolutions per minute. These develop a voltage of 3,300 volts with a frequency of twenty-five cycles per second. As the principal load on the station is that imposed by the single-phase locomotive demand, these three-phase machines were specified to furnish their full rated load of 1,250-kilowatt, single-phase current. The turbines are, roughly, thirty-seven feet over all, eight feet high and six feet wide. The generators are air-cooled by a self-induced draft provided by vanes on the rotor. Each turbine exhausts into a barometric jet-condenser



PLAN VIEW OF THE STEAM POWER PLANT FOR THE ST. CLAIR TUNNEL ELECTRIFICATION.

with a thirty-inch inlet, manufactured by the H. L. Worthington Company. An automatic release valve may be connected to the free exhaust piping. Condenser cooling water, obtained from the St. Clair River through a concrete and tile intake, is circulated by a ten-inch volute pump driven by seven by nine-inch vertical engines. Rotative straight-line vacuum pumps are supplied with each condensing equipment. Two twenty-five-kilowatt steam-driven exciters are provided, either one of which is sufficient to furnish excitation for a single turbine unit. A motor-driven exciter of forty kilowatts capacity is ordinarily used in the operation of the plant. A three-phase, 3,300-volt induction motor of the squirrel-cage type drives this machine. All of the excitation apparatus—engines, motors and generators—is of Westinghouse manufacture.



CROSS SECTIONAL ELEVATION OF THE STEAM POWER PLANT FOR THE ST. CLAIR TUNNEL ELECTRIFICATION.

The switchboard, which is mounted on the turbine-room-floor level, contains ten panels, arranged in order from the left as follows: On the first panel is mounted a Tirrill regulator, voltmeters, a frequency meter and synchroscope; the second panel controls the steam-driven exciters; next, a panel controlling the motor-driven exciter; a panel controlling current supply for light and power within the plant, two turbo-generator controlling panels; the locomotive feeder panel; one for the pumping feeders; one for the power and light feeders, and one for the control of the arc-light circuits. No high-tension current is brought to the switchboard itself, all of the high-voltage oil switches being mounted on steel framework in the switch room behind the board. Direct current at 125 volts, supplying excitation, is controlled directly from the main switchboard. The 110-volt lighting current for the power plant is stepped down by transformers from the 3,300-volt generator buses, or by means of a throw-over switch, can be derived from the exciter bus-bars. The entire lighting load, it should be noted, is carried on the locomotive phase. A close regulation of this voltage is secured by means of the Tirrill regulator, which operates so effectively that only an instantaneous diminution of the luminosity of the lamps is apparent during heavy acceleration of the locomotives.

The switchboard panels in general are provided with the usual apparatus, such as ammeters, voltmeters, and indicating wattmeters. Recording wattmeters are arranged to measure the output of the plant required for the various kinds of service furnished. From the operating engineer's station in front of the switchboard, all of the electrical instruments and switches are accessible, while across the turbine-room floor is a gauge-board reporting the complete operation of the boiler plant. A fifteen-ton hand-power traveling crane, manufactured by the Northern Engineering Works, is installed on overhead tracks in the turbine room, and may be used to handle any piece of apparatus in the station.

It is evident that of equal importance with the propulsion of the locomotives through the tunnel, is the reliable maintenance of the tube free from water, since in the case of the tunnel becoming flooded, either from seepage or drainage of rain water, the operation of trains would necessarily be suspended. The Port Huron approach to the tunnel has an area of eleven acres, while the Sarnia approach has an area of thirteen acres. Waste ditches are provided at the side, arranged with retaining levees, constructed to impound a large portion of the water falling on the approaches.

Before the electrification, boiler plants were provided at each portal for the operation of drainage pumps, and in order to take care of any rainfall which might occur it was necessary to keep fires under the boilers and maintain attendants at the pump houses at all hours for a large proportion of the year.

From the Port Huron generating plant three-phase power leads are led down the vertical shaft to the tunnel, and carried in both directions through the tunnels, in paper-insulated, lead-covered cables in ducts at either side of the tube. Emerging from the tunnel portals, the conduits enter the adjacent pump houses supplying three-phase, twenty-five-cycle, 3,300-volt induction motors driving centrifugal pumps. At the Port Huron entrance are two such pumps, each capable of delivering 4,000 gallons per minute, driven by 100-horsepower motors; while at the Sarnia entrance are two 5,500-gallon pumps driven by 200-horsepower motors. At each pump house there is an additional 150-gallon pump driven by a small induction motor, to rid the wells of the small amount of seepage water that is continually percolating into the tunnel. These pumps need be operated for only a few hours daily. The pump-motor busbars may be supplied from two independent feeders from the power plant. The motor control is effected by means of oil switches on individual panels. As noted before, the flat portion of the tunnel has a slight grade (one-tenth per cent) in the direction of the Sarnia end. In order to dispose of the slight flow of seepage water, at the junction of the Sarnia grade and the flat section—the lowest point in the tunnel—two 150-gallon, motor-operated centrifugal pumps are located. These pumps are similar to those at the portal pump house, with the modification of being entirely enclosed and suitable for continuous operation in the tunnel, subject to conditions of moisture and condensation. These pumps discharge into the drainage well, from which the portal pumps lift the water to the outer level.

Since the electrification, the tunnel walls have been whitened and incandescent lamps placed every twelve and one-half feet throughout the tube in a staggered relation on either side, at a height of about ten feet. The tunnel lamps, of which there are 480, are operated four in series from the 440-volt secondaries of lighting transformers placed at intervals in the tunnel. A similar set of transformers furnishes current for the tunnel drainage-pump motors.

From the pump houses at either portal the lighting and power feeders emerge from conduits, and are carried as overhead conductors on the extended masts of one of the overhead-trolley structure standards. Incandescent lamps in the roundhouses, passenger stations and railroad buildings in both Port Huron and

BOILER ROOM OF THE POWER PLANT, SHOWING AUTOMATIC STOKERS AND REGULATOR WHICH MEETS PEAK LOADS AUTOMATICALLY BY ACCELERATING COMBUSTION.

Sarnia, are furnished from these lines by means of suitable transformers, reducing the 3,300-volt line potential to 110 volts. In the yards of the terminals are about thirty arc lamps, used for general illumination. Unidirectional current for these lamps is furnished by means of a mercury-arc rectifier. The total amount of lighting load is less than 100 kilowatts. At the roundhouse at Port Huron and Sarnia are 3,300-volt motors, supplied from the tunnel power plant, but the entire connected motor load does not exceed 100 kilowatts. Thus the power house is called upon to furnish slightly over 200 kilowatts for lighting and power outside the plant.

Since for the operation of the trains steam is always maintained in the boilers, the starting of the motor pumps following a rainstorm is a very simple matter, and does not require, as with the old steam-pump houses, separate fires and steam pressures for a large portion of the year.

The Tunnel division block-signal system extends from the American to the Canadian summit. In addition to telegraph orders, the conductor is handed a staff when the train enters the tunnel division. The switch and signals then remain locked until this staff is placed in the instrument at the other end of the block. It is said that not a single accident has occurred as the result of improper dispatching during the eighteen years' operation of the tunnel. Additional telephone communication is provided between the switch cabins, the power house and the officials' offices at the town stations. Telephone and telegraph cables extend the entire length of the tunnel.

On Thursday, November 12, as the result of invitations issued by the Grand Trunk Railway to more than 100 prominent railway officials and engineers, and representatives of the technical and public press, on the occasion of the official acceptance of the electrification, an inspection trip through the tunnel and power house was made, a feature of which was the congratulatory luncheon at the Hotel Vendome in Sarnia. Six large new flat-cars had been provided with upholstered coach seats and generously decorated with the national colors of Great Britain and the United States. At 1 o'clock these were boarded by the party and, drawn by a pair of electric locomotives, a slow run was made through the tunnel in order to allow the visitors to examine the features of construction. The tunnel walls had been whitened, the air was pure and cool, and the long row of tunnel lights could be seen converging to the point of change in the grade. The tunnel thus presents a marked contrast to the previous conditions, when a quick trip in closed coaches, behind a steam locomotive, was accompanied by great discomfort and indeed an element of danger, from smoke and asphyxiation.

Arriving at the Sarnia station, the party entered a special train of coaches and were taken to the Vendome Hotel, where a completely appointed luncheon was served. With E. H. Fitzhugh, third vice-president of the Grand Trunk Railway system, presiding in the stead of Charles M. Hays, general manager of the system, who was unable to be present, a series of toasts and speeches were given commemorative of the completion of the tunnel. After the assembled guests had responded to the dictates of international courtesy and good feeling with toasts to King Edward and President Roosevelt, whose names were greeted with hearty applause, Mr. Fitzhugh introduced the venerable Joseph Hobson, who was the chief engineer of the St. Clair Tunnel during its construction. Mr. Hobson is now consulting engineer for the Grand Trunk system. Bion J. Arnold of Chicago, consulting engineer for the Grand Trunk during the electrification of the St. Clair Tunnel, was next introduced and gave a short history of the men and installations that have advanced electric railroading. F. A. Sager, assistant engineer for the Arnold Company, proposed a toast to the Westinghouse Electric and Manufacturing Company, which was represented in the response by C. L. Williams. Cy Warman, who is best known as a writer of railroad stories, made a clever speech, and international amenities were further exchanged in speeches by the mayors of Port Huron and Sarnia, who were next called upon. Following the luncheon, the special train was again boarded, the tunnel trip was made, this time in coaches, and the visitors were delivered at the power house on the Port Huron shore. After an hour spent in careful inspection of this architecturally and mechanically beautiful station, during which the visitors admired the excellence of the maintenance and the ingenuity of the automatic boiler-plant devices, the party returned to the cars and was taken to the Port Huron Depot. Here, so far as the formal programme was concerned, the inspection ceremonies ended, but the majority of the engineers and visitors made a merry dinner party, with some postprandial story-telling features at the Hotel Harrington, before taking the evening trains for their destinations, east and west.

The electrification of the St. Clair Tunnel was undertaken by the Westinghouse Electric and Manufacturing Company, which contracted to be responsible for the installation and successful operation of the entire equipment, a condition which it has now satisfied in the fullest degree. Bion J. Arnold of Chicago was the consulting engineer for the railroad company, whose officials, C. M. Hays, second vice-president and general manager, and E. H. Fitzhugh, third vice-president, took a leading part in the move to electrify. The Westinghouse company's representative on the installation was H. L. Kirker.

Progress on the Detroit Tunnels.

The steel twin tubes of the Michigan Central Railroad's tunnel under the Detroit River from Detroit, Mich., to Windsor, Ont., have now been carried to a point more than half way under the river from the American side. Six of the ten great steel sections are already sunk in the channel and a seventh has been delivered at the work and now lies moored to the Detroit shore. The manner of building the tunnels is said to be unique in this kind of construction. The steel sections have their ends boarded and calked to be water-tight and are floated to position by tugs. Valves are then opened and the section is allowed to settle into place in the trench previously dredged in the river bottom. Air tanks carried on the section lighten it while it is being adjusted into position by the aid of tongues and eyes. A water-tight joint is made between the sections by immense rubber gaskets which fit into grooves in the steel end-rings. Accurate alignment of the tunnel sections is secured by sighting through an instrument from shore, the structural steel masts rigidly mounted upon the sections and extending several feet above the surface of the water when sunken. Heavy board forms of rectangular section enclose the tubes before sinking, and the space between the square and circular sections is pumped full of concrete. After placing the tunnel tubes in position the steel and concrete are covered with a layer of clay obtained from the river bottom. The steel tubes are to be given an internal concrete lining. Both

of the concrete approaches on the shore ends are nearing completion and will be ready for use by the time the subaqueous tubes are finished. Work has been suspended for the winter on the placing of more sections, since the water has become too cold for the divers, but the time will be profitably spent in pumping the water out of the tunnel already laid and in finishing work on its interior. The contract date for completion is June 1, 1909, but there is little probability that this enormous undertaking can be finished within a number of months of that time.

The electrification of the Detroit tunnel will be carried out by the General Electric Company, which will install a third-rail direct-current system with a storage battery to meet the high peak loads. Power will be purchased from the Detroit Edison Company, whose 25-cycle, 4,400-volt alternating current will be converted by means of two 1,000-kilowatt synchronous motor-generator sets into 650-volt direct current. The pumping and lighting systems will be operated from alternating-current mains. The electrified zone will be 4.6 miles in length, and with the yards will comprise fifteen miles of track. Several of the locomotives for this service have already been completed by the General Electric Company.

Mineral Products of the Last Ten Years.

The United States Geological Survey, under the direction of George Otis Smith, has prepared a comprehensive table giving the amount and market value of the mineral products of the United States for the years 1898 to 1907, inclusive. Returns are given for sixty-seven products classified into metals, fuels, structural materials, abrasive materials, chemical materials, pigments and miscellaneous products. From this table the figures given below are of interest to the electrical arts. The table was prepared by Edward W. Parker, statistician in charge of mineral resources.

	PRODUCTS.		1898.		1899.		1900.		1901.	
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1	Copper, Value at New York City	Pounds	526,512,987	$61,865,276	568,666,921	$101,222,712	606,117,166	$98,494,039	602,072,519	$87,300,515
2	Aluminum, Value at Pittsburg	Pounds	5,200,000	1,716,000	6,500,000	1,716,000	7,150,000	1,920,000	7,150,000	2,238,000
3	Bituminous Coal	Short tons	166,593,623	132,608,713	193,323,187	167,952,104	212,316,112	220,930,313	225,828,149	236,422,049
4	Pennsylvania Anthracite	Long tons	47,663,076	75,414,537	53,944,647	88,142,130	51,221,353	85,757,851	60,242,560	112,504,020
5	Natural Gas			15,296,813		20,074,873		23,698,674		27,066,077
6	Petroleum	Barrels	55,364,230	44,193,359	57,070,850	64,603,904	63,620,529	75,989,313	69,389,194	66,417,335
7	Mica (sheet)	Pounds	129,500	103,534	108,570	70,587	456,283	92,758	360,060	98,859
8	Mica (scrap)	Short tons	3,999	27,564	1,505	50,878	5,497	55,202	2,171	19,719
9	Tungsten	Short tons					46	11,040	179	27,720

	1902.		1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1	$659,508,644	$ 76,568,954	698,044,517	$ 91,506,006	812,537,267	$105,629,845	901,907,843	$139,795,716	917,805,682	$177,595,888	868,996,491	$173,799,300
2	7,300,000	2,284,590	7,500,000	2,284,900	8,600,000	2,477,000	11,347,000	3,246,300	14,910,000	4,262,286	17,211,039	4,926,948
3	260,216,844	290,858,483	282,749,348	351,687,933	278,659,689	305,397,001	315,062,785	334,658,294	342,874,867	381,162,115	394,759,112	451,214,842
4	36,940,710	76,173,586	66,613,454	152,036,448	65,318,490	138,974,020	69,339,152	141,879,000	63,645,010	131,917,694	76,432,421	163,584,056
5		30,867,863		35,807,860		38,496,760		41,562,855		46,873,932		52,866,835
6	88,766,916	71,178,910	100,461,337	94,694,050	117,080,960	101,175,455	134,717,580	84,157,399	126,493,936	92,444,735	166,095,335	120,106,749
7	373,266	83,843	49,600	118,088	668,358	109,462	924,875	160,732	1,423,100	252,248	1,060,182	349,311
8	1,400	35,006	1,659	25,040	1,096	10,854	1,126	17,856	1,489	22,742	3,025	42,800
9	184	34,040	292	43,639	740	184,000	803	268,676	928	348,867	1,640	890,048

New York Public Service Commission Gives Hearing on Proposed Wilgus Freight Subway.

The Public Service Commission held a hearing in New York on November 11 on the proposed Wilgus freight subway, which the Amsterdam Corporation is seeking to build, and which is intended to facilitate the handling of goods between the railroad freight terminals and the points of wholesale distribution.

W. J. Wilgus, speaking for the project, said that less than half of the water front is open to use by foreign and coastwise trade steamship lines. The major part of the rest is used by the railroads, which are constantly asking for more space. Mr. Wilgus dwelt on the fact that of the 100,000,000 tons of freight brought into the city, 27,000,000 tons are hauled by drayage in the city, and speedier and more economical methods are needed, the average cost at present to haul one ton through the city is equal to the cost to haul by train 400 miles.

The plan includes a gravity yard in New Jersey west of the Bergen Hills, from which, after classification, the small standard-gauge cars will be brought under the river and up a line extending along the North River from the Sixtieth Street yards of the New York Central to the Battery, and up the East River to connect with the railroads in the Bronx. It is expected that ninety per cent of lower New York's freight can be handled in this way. There would be a crosstown line at some convenient point north of Twenty-third Street, and there would be facilities to carry passengers in the subway.

Mr. Wilgus went into the objections against the plan, and suggested remedies. Representatives of commercial and civic organizations argued generally for the end for which the subway is proposed, but objected to some of the locations traversed, and suggested extensions to cover outside territories in order to relieve the factory congestion of lower New York.

A proposed substitute for the Wilgus plan was a combined subway and surface road along the West Side water front similar to the arrangement in many of the European cities. General discussion followed.

Pennsylvania Electrification.

It is stated that the Westinghouse Electric and Manufacturing Company will not begin the building of electric locomotives for the Pennsylvania Railroad for several weeks. No definite decision has been reached as to whether the third-rail or single-phase system will be used, although an agreement will be reached in the near future.

The contract with the Westinghouse company calls for the electrification of the Pennsylvania terminals at Long Island, Manhattan and Jersey City. Electric trains will be operated as far as Harrison, N. J. It is probable that the Pennsylvania will eventually install electricity on its lines between New York and Philadelphia.

ELECTRIC HEATING.

231ST MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK CITY, NOVEMBER 13.

The 231st meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York, N. Y., on Friday evening, November 13. The meeting was called to order by President Louis A. Ferguson, and Secretary Pope announced that at the meeting of the Board of Directors held during the afternoon there were fifty-nine associates elected. It was also announced that the new by-laws had been revised and would go into effect. These will be circulated as soon as they can be printed.

The paper of the evening was on the subject of "Electric Heating," by W. S. Hadaway, Jr. An abstract of this paper follows:

The term "electric heating" is commonly used to express the filtering down of a higher potential energy of electricity into the lower potential energy of heat. Mr. Hadaway considers that the expression, "electricity, a factor in a telethermic system," would be a better definition.

Heat energy is to be regarded as a commodity that can be generated and controlled in convenient form, and distributed and sold, and in which electricity is used either directly as the high-potential heat factor, or indirectly as an agent. The feature of the subject under consideration is the practical adaptability of commercial electricity for heating purposes and for performing useful work under the conditions imposed in general industrial and domestic life. These applications may be roughly divided into two classes, according to the degree of concentration of the heat energy used. The first class includes low-temperature heating, generally diffused and in large volumes. The second class includes high-temperature heating, generally localized and in small quantity.

The electrical unit, or kilowatt-hour, is the equivalent of 3,412 British thermal units. For practical purposes the work in hand is to determine the useful work in different lines which is obtainable from this number of heat units at a fair average cost of supply.

It has been determined that with a platinum wire held in a flame less than 0.5 per cent of the thermal energy produced in the flame was transferred to the wire, while ninety per cent of the electrical energy used appeared as heat. In another case an iron bar weighing about twenty pounds was heated by charcoal and then by electricity. In the former case about 0.75 per cent of the thermal energy was transferred to the bar, and in the latter case eighty-eight per cent.

In room-heating apparatus on continuous run we may estimate that one watt-hour (3.41 thermal units) will heat one square foot of common radiator surface through 1.26 degrees Fahrenheit; that 1,000 watt-hours, or 3,410 thermal units, will heat the surface approximately 126 degrees Fahrenheit above the room temperature. That is, for room heating from eighty-five to 100 watt-hours are practically the equivalent of steam at low pressure, condensed by one square foot of radiator surface, with the difference between the room and the radiator temperatures as above stated. We may safely assume that a fair average price of the electrical unit from large steam-electric stations is 6.7 cents. It would, therefore, cost 0.65 cent, average, to run one square foot of direct radiation surface for one hour, or the electrical unit would keep about 10.3 square feet of radiator surface at the temperature difference noted for one hour.

The steam-driven electric-light station ranks low as a heat distributor for house warming on any considerable scale, yet notwithstanding the great disparities in the cost of heat energy on a large scale, the uses to which small electric air-heaters are put are surprisingly numerous.

It is then on a comparatively small scale, and in intermittent service, that the electric air-heater is useful when power is derived from the steam-electric station, and when the heat supply is derived from electric resistance.

We must not under-rate the facility with which gas may be stored, the economy of rapid and continuous generation and available heat from combustion and discharges of by-products; whereas, in electric lighting and electric heating every unit of heat and light secured represents an appreciable loss or depreciation of the energy converter. It may be safely concluded that we cannot afford to use electricity for general diffused heating purposes on a large scale. Practical experience, however, shows that such deductions may lead to unsafe conclusions. Many practical illustrations are found, which show that no great engineering difficulties are encountered in distributing boiler energy, and also exhaust steam from the engine, for useful heating work at a distance. We are now able to formulate a multi-potential heat-supply system in which the steam, either live or exhaust, or both, is used for low-temperature work, and electricity from generators in the same station is employed for all work requiring temperatures in excess of that of the steam—that is, from about 250 degrees Fahrenheit upward. In domestic work the steam heat would be employed for house heating and water heating, for bathing, laundry and cooking purposes. Electric heat would be used for lamps, ovens, broilers, small stoves, sad-irons and all purposes requiring high-temperature localized heat. A total fuel efficiency exceeding thirty-five per cent for both low and high temperature heating is obtainable, and probably a still higher efficiency may be secured from operations on a large scale. It is in this direction that we must look for the best immediate results of electric heating in domestic life. Electrical engineers realize that the ordinary light and power station is wasteful as a heat generator and distributor, and one of the ways to improve these conditions is to introduce a basis of supply in which the load-factor is a larger percentage of the station capacity, and in which low-temperature steam distribution may also be utilized. In the modern apartment house we find it possible to effect a comparatively high distributive heat efficiency. The rooms are heated by low-pressure steam or hot-water radiation, and the hot water for laundry, bath room and cooking purposes is also supplied. Electric lighting is available, but low-heat efficiency is found in cooking except in cases where gas is available. No one can question the value of gas as a fuel in cooking. We may, however, take the ground that when a boiler plant is required for room and water heating, and an electric plant for lighting, the use of gas in cooking is unnecessary and comparatively expensive, for it is a form of heat supply not as effectively localized as electricity, and is accompanied by many disagreeable features. In these houses electricity is already in use instead of alcohol for heating convenience, also for heating sad-irons for laundry work and pressing; and it appears to be a question of time only when electric ovens and other cooking

utensils will replace the range or the gas stove on a considerable scale.

There are some installations in which all or nearly all the cooking is done by electricity. These are generally successful and economical, according to the degree to which extensive water heating is eliminated. Laundry and pressing irons are found almost uniformly satisfactory. Some of the devices used in the dining room are accounted great conveniences when electrically heated. When it comes to the kitchen the same feeling of cleanliness and refinement of methods as for the dining room is expressed and hoped for, but the housewife is not so ultimately in contact with the apparatus, and ignorant manipulation is encountered, which, however, does no other harm than to add to the expense of running.

In industrial work the progress of electricity has been more rapid than in domestic applications, with the exception of the electric sad-iron. There are cases where heating by electricity is found cheaper than by fuels, setting aside all collateral advantages. In electric cars the more equitable distribution of heat on a satisfactory basis of effective warming is sufficient to employ the method and apparatus even at considerably greater cost than former methods of heating.

Following the reading of this paper, President Ferguson announced that two written discussions had been contributed by Charles E. Waddell, electrical engineer of the Biltmore Estate, Asheville, N. C., and by W. N. Ryerson, superintendent of the Ontario Power Company, Niagara Falls, Ontario. Percy H. Thomas abstracted these contributions.

Mr. Ryerson considers that Mr. Hadaway's suggestions concerning the limitations of the use of electricity for maintaining an equitable temperature in buildings during the season of cold weather are undoubtedly to the point at the present time. There are instances, however, in which comparison between the use of electricity and other heating agents on the basis of cost leads to erroneous conclusions. As an instance in point, in the office building of the Ontario Power Company, at Niagara Falls, which was equipped, under the plans of the architects, with a low-pressure steam-heating system having an auxiliary hot-water system with forced draft, it has been found that the low-pressure steam system is entirely unnecessary, a comfortable temperature being maintained in the coldest weather by an electrically-heated hot-air system designed by himself. It is true that the steam-heating system in this building is a part of a much more extensive one installed throughout the transformer building, of which the office forms an ell, but it is not necessary to maintain a high temperature throughout the remainder of the building, with the exception of the switchboard room, which is heated by direct electric radiators. During the last winter it was found that the use of the boiler was only necessary for twenty-five days, and during the remainder of the time the electric heaters in the office building and switchboard room were sufficient for all purposes. The cost of this electric heater was $388, and it consumes eighty-five kilowatts, including power necessary for a fan motor. In a plant of this size the cost of this amount of energy is negligible, whereas with natural gas and wages of boiler attendants, a large cost would be built up. The electric heater supplies 72,000 cubic feet of air space in a building exposed on three sides.

The Ontario Power Company purchased and installed a complete electric kitchen capable of cooking a meal for 300 persons, and its successful use has been demonstrated on several occasions.

Mr. Waddell considered that dividing heat applications into low-potential quantity and high-potential intensity types is a very expressive way of classifying two general conditions. In high-potential heating problems it has been demonstrated that the cost of electrical energy has little or no bearing on economy. Other factors enter that more than compensate for any discrepancy in calorific value between electricity and fuels.

It is doubtless true that the steam power plant, by reason of its low efficiency, is debarred from furnishing electric heat in competition with fuels. In the case of a thickly-settled district the use of exhaust steam for heating has been demonstrated as profitable and desirable. As Mr. Hadaway suggested, conditions may be such that it might be profitable to generate electricity for high-potential applications and use the exhaust steam for quantity work.

In house heating the efficiency of the apparatus depends almost entirely on the range of temperature in the apparatus and on the method of controlling the fires. Another point that has impressed Mr. Waddell is that not only the quantity, but the intensity of heat in domestic applications is essential to success. If electric heating is to be introduced on a large scale into house warming, it will be necessary to accord the art of heating and ventilation more scientific attention than is now usually bestowed upon this class of work. Unquestionably, of the quantity of heat annually radiated in domestic installations, the greater portion is wasted.

President Ferguson called upon W. S. Andrews to continue the discussion.

Mr. Andrews said that it had been his privilege to be associated with Mr. Edison while he was developing his low-tension, multiple-arc system of electrical distribution in the early eighties. He distinctly remembered a statement which Edison made in 1881, to the effect that he expected to utilize the general distribution of low-potential electrical energy not alone for public and private lighting purposes, but also for operating electric motors, to drive machinery in mills and factories, and for electric traction; and furthermore, he confidently expected to make electricity generally serviceable for the cooking of food, and, to a limited extent, for the warming of dwellings. Mr. Andrews agreed with Mr. Hadaway that the real difficulty in using electricity for performing ordinary cooking operations exists in the providing for a hot-water supply economically. At a price of five cents per kilowatt-hour the cost of heating a gallon of water from faucet temperature to boiling point, at an efficiency of, say, eighty per cent, is a little more than two cents, which, to many people, would be a prohibitive price, especially as the same result can be accomplished for very much less money. Apart from the question of water heating, the operations of baking, broiling, frying, toasting, etc., by electricity can be accomplished at a reasonable expense when electricity is sold at the rate of five cents per kilowatt-hour. Taking into consideration the collateral advantage of being able to raise utensils to a high temperature with localized heat, thus keeping the kitchen much cooler in hot weather than is possible when using a coal or gas range, increases the advantage of electrical service.

James I. Ayer said that the paper of the evening should be analyzed and a more optimistic view taken of the possibilities of electric heating. Mr. Ayer considers that the likelihood of the use of steam from a central station proving an important factor in developing electric heating is doubtful. Steam heating from electric central stations is not considered by those

who are exploiting such systems as something they can recommend generally, and the limitation of such development has been in no manner affected by electric heating.

Concerning the competition between gas and electricity, remarkable results in development have come about. In this struggle electric heating already plays its part to a limited, though very beneficial, extent. With no important single installation of electric heaters exceeding a few kilowatts, one central station reports a total of 1,560 heating devices on its lines, having 696 kilowatts' capacity, producing an increased load of 132,000 kilowatt-hours per year, and a gross revenue for the service of $18,000, practically all at lighting rates.

Paul M. Lincoln said that electric heating must compete with other means of arriving at the same end. To win out, the electrical method must show a higher efficiency than any other method of obtaining heat. One of the big advantages with electrical apparatus is, of course, that it can be applied to the work in a much better way than by any other method.

H. P. Ball said that it was feasible, by using modern materials such as nickel-chromium wire and infusible materials, to get a very high temperature, and this was what was needed. In heating rooms, the use of a resistance conductor in the form of a thin, wide band, so as to have a maximum radiating surface, is necessary.

Max Loewenthal said that there can be no doubt that electricity converted into heat cannot be as efficient for any operation as steam generated from fuel. Again, as a general proposition, electricity converted into heat is not commercially as efficient as gas. On the other hand, figures are available which show that the electric oven, for example, compares very favorably with an oven in which solid fuel is burned. When it is considered that the fuel burned in a coal range delivers only 2.5 per cent of the thermal value of the fuel for heating the food, and in a gas stove, from three to 3.5 per cent is secured; while with the electric oven, considering the conversion of energy from steam energy into electrical energy, and assuming an efficiency of the oven of about eighty-five to ninety per cent, the percentage with electricity runs up to 4.5, the economical advantage can be seen. Making careful calculations, based upon actual figures, if the rate for electricity is reduced to 2.5 cents per kilowatt-hour, it will be identical with gas at $1 per thousand cubic feet. The final solution of the problem of using electricity for general heating will be found when the central station can reduce the cost of current to where it will be as economical to cook with electricity as with any other means.

As far as the technical development is concerned, Mr. Loewenthal believes that the resistance material will be of a refractory character more in the nature of a carbide. Samples have just been received of a European product for heating purposes—a silicate of carbon—which may be heated for a great many hours without showing any deterioration at all.

Dr. C. P. Steinmetz took up the discussion and indicated the disadvantages and handicaps under which the development of general electric heating labors. The solution of the practicable utilization of electricity for heating leads up to a method of transforming heat energy from high-pressure, low-quantity, to low-pressure, high-quantity. If you admit heat at a high temperature, a small quantity expanded down is converted into mechanical energy. By going from very high temperature to low temperature, probably fifty per cent can be converted. Carrying out the reverse process at lower temperatures, an amount of heat quantity units several times larger than the heat quantities put in at the higher temperature can be secured. Heat energy is convertible into any other form of energy or fixed equivalent of heat, but heat quantity corresponds to quantity of electricity, corresponds to current, and has no direct relation to energy, but is one of the factors of producing energy. The smaller the electromotive force, the larger may be the other factor with the same amount of energy. This mixing up is partly due to the nature of the energy transformation between chemical energy and heat energy. If we interpose the electric transformer or converter, and change from high electromotive force and small current to low electromotive force and high current, we can get a much larger output by using a much larger quantity of electric energy.

Mr. Hadaway, in closing the discussion, stated that it had been his desire to make his paper very conservative, and that, in his opinion, the thing to be considered mainly was the confining of the heat.

Before adjourning, President Ferguson stated that the next meeting of the Institute would be extremely interesting, the subject for discussion being the experiences in the electrification of the New York, New Haven & Hartford Railroad. The paper would be presented by W. S. Murray, chief electrical engineer of the system.

The meeting was then adjourned.

Reorganization of New York Metropolitan.

It was announced on November 13 that the problem of reorganizing the finances and properties of the Metropolitan Street Railway Company, in New York city, will be taken up at once by a committee representing the bondholders. The committee's work, which will require, as a preliminary, a thorough analysis of the financial and physical factors involved, will be prosecuted, it is promised, with the utmost speed, with the object of evolving a comprehensive plan of readjustment.

Both the committees representing the general and collateral five per cent bonds and the refunding four per cent bonds of the Metropolitan Street Railway Company are represented in the Reorganization Committee, which consists of four members. Donald Mackey and William P. Dixon represent on the joint committee the general and collateral mortgage five per cent bonds, and John W. Castles and Otto H. Kahn the refunding fours. In addition to these, Alexander J. Hemphill, chairman of the first-named Bondholders' Committee, and E. S. Marston, chairman of the latter, have been designated by their respective committees to act, ex-officio, in an advisory capacity to the joint committee. John W. Castles has been named chairman of the committee and Alexander Hemphill, secretary, with L. C. Krauthoff as counsel.

Civil Service Examinations for New York State and County Service

The New York State Civil Service Commission will hold examinations on December 12 to fill the position of junior draftsman, Public Service Commission, First District, $720 to $1,200 per annum. The last day for filing applications for this position is December 5. Full information and application forms may be obtained from Charles S. Fowler, Chief Examiner, Albany, N. Y.

Association of Car-Lighting Engineers.

First Annual Meeting Held at the Grand Pacific Hotel, Chicago, November 16 to 20.

The first annual meeting of the Association of Car-Lighting Engineers was called to order on Monday morning, November 16, in the German Room of the Grand Pacific Hotel, Chicago. There was a large and enthusiastic attendance, and the opening session indicated that this was a very live organization, and that there was in store for it a future of much service and value to the car-lighting engineers and the railroads with which they are connected.

The opening session was called to order by President A. J. Farrelly, of the Chicago & Northwestern Railway. Mr. Farrelly rehearsed very briefly the organization of the association. On May 20 last ten men, representing four of the large railroads, gathered together at Ogden, Utah, to discuss several points of difference which had involved the different organizations, and during the discussion it was suggested by E. M. Cutting, of the Southern Pacific, that an organization of car-lighting engineers be started. In response to some correspondence which was then carried on, a meeting was held in the Grand Pacific Hotel, in Chicago, last August, with about forty men present, and an organization effected with the following officers: President, A. J. Farrelly; first vice-president, E. M. Cutting; second vice-president, A. J. Collett, Union Pacific; secretary and treasurer, G. B. Colegrove, Illinois Central. Executive committee—H. C. Meloy, Lake Shore & Michigan Southern; A. C. Terry, "Soo;" G. W. Murray, San Pedro, Los Angeles & Salt Lake, and O. W. Ott, Oregon Short Line.

The objects of the association are to tie together the loose threads which have predominated in car-lighting engineering. While the apparatus has been standardized and perfected to a considerable degree, there is but little uniformity of installation and equipment. Except on a few of the larger roads there has been a tendency to utilize any kind of a light, in any kind of a way, and let it go at that. It is the opinion, however, of progressive railway men that one of the greatest features of attraction in railway service is adequate lighting, and to-day there is need for considerable study and interchange of ideas which would bring about that betterment of service for which all car-lighting engineers should strive in performing their full duty to their employers.

The report of Secretary-Treasurer Colegrove showed that there were 205 members; that the collections had amounted to $410, and that the expenditures outside of the cost of printing for the present convention were $108.65, leaving a balance in the treasury of $301.35.

The first paper was read by Patrick Kennedy, entitled "History of Car Lighting." This paper called attention to the valuable contributions to the literature of train lighting which had been made by Prof. George A. Shepardson, of the University of Minnesota, and by A. H. Bauer. The advantages of electrically lighting railroad cars were realized very early in the development of incandescent electric lighting, and the efforts of electrical engineers to utilize electric lamps for car illumination were contemporary with the earliest manufacture of incandescent lamps. Prior to the installation of the first Edison system in New York the London & Brighton Railway operated an electrically lighted car from a battery of Faure cells. The Pennsylvania Railroad, in the spring of 1882, equipped a number of its cars, taking current from imported Faure cells, and considerable experimentation was done with primary batteries for car lighting from 1883 to 1887 in France and America. It was recommended that a committee be appointed to prepare a complete historical treatise dealing with the subject of car lighting by electricity.

In the course of his paper, Mr. Kennedy called attention to various patents which had been granted for systems of car lighting. One of these, he said, consisted of a windmill, which was placed on the locomotive, and which was expected to generate enough current to light the train and perform some other service.

During the remarks which followed the reading of Mr. Kennedy's paper, it developed that Alexander McGary, chief electrician of the New York Central, was the expert who undertook the testing out of this installation. Notwithstanding the fact that this is now looked upon as more or less of an absurdity, it was nevertheless practicable, and it appeared at that time that a large syndicate would be organized to develop it. The installation consisted of a thirty-six-inch Sturtevant wheel equipped with a damper gate for cutting off the wind pressure as the locomotive would meet a new slant of the wind when rounding a curve or changing its direction. It was installed on a locomotive on the Grand Rapids & Indiana, running between Grand Rapids and Muskegon, Mich. The generator developed twenty-five amperes at eighty-five volts. Of course, with the controlling devices at that time available, it was not possible to regulate the voltage or maintain anything like decent illumination, and pending the construction of a better form of wheel and controller, the development of this system was allowed to lapse.

A paper entitled "The History of Axle Lighting" was presented by W. L. Bliss. This was a classical resumé of the past and present efforts made in the development of a successful axle lighting system. Mr. Bliss paid a warm tribute to those who had, along with him, done the pioneer work in bringing to the present-day perfection the system of axle lighting with which large numbers of cars are now equipped. He described the many difficulties which were overcome, and indicated the probable trend of invention and design in meeting those difficulties which it is now considered are about to be solved. The history of axle lighting is as old as any development of car lighting. From the earliest days efforts have been made to light trains electrically by means of a generator driven from the axle through some form of transmission. The first patent with which he had any acquaintance was taken out in England in 1881, by Richard Lalor, and is numbered 5,316. In America he thought that among those men who were now living, and who had been interested for the greater part of their lives in developing a system of axle lighting, in point of time of service the leader was Morris Moskowitz; that second place belonged to Patrick Kennedy, and that he himself was entitled to third place.

Mr. Bliss illuminated his paper with many amusing reminiscences and references to the early work of inventors, and made a number of excellent suggestions

concerning the perfect system of train lighting which now is in fair shape to be realized.

The session then stood adjourned until 2 p. m.

The afternoon session was opened shortly after 2 o'clock, when President Farelly announced the report of the committee on the care and maintenance of storage batteries, comprised of F. R. Frost, W. F. Bauer, Dr. J. E. Widner and H. M. Beck. The paper was read by the first named, as chairman. Though the report was not lengthy, it was very comprehensive, and in a terse way set forth a great amount of valuable information concerning the storage battery and its use.

After an introductory paragraph, in which the systematic and intelligent attention to batteries at frequent intervals was strongly advised, the authors struck at once into the controversy of lead-lined tanks versus rubber jars, by summing up the following advantages for each class of container. Over the rubber jar the lead-lined tank prevailed, they declared, in its ability to withstand severe shocks, its slightly lower first cost, the value of its salvage as scrap and the greater ease of repair. On the other hand, rubber jars were stated to weigh less, to require no special care to prevent the action of wood, acids and grounds, to need no insulation to prevent short-circuiting the elements, and to show a lesser tendency for the electrolyte to creep.

The following suggestions were made for battery cell construction used in railway train-lighting work: Rubber jars were recommended to be three-sixteenths inch thick, with reinforced tops and with bridges not less than one and three-fourths inches thick. Lead linings should be made of lead weighing not less than four pounds per square foot with all laps burned, the use of solder not being permissible. Oak crates with dovetailed corners were advised, thoroughly painted inside and out with an acid-resisting paint. Jars and linings should be set in a low-melting compound, the report said, permitting of their easy removal when filled with hot water. Connectors of No. 4 or No. 6 cable, containing at least forty-nine strands and insulated with best quality rubber, were advised. For terminals brass is inferior to copper. All metal parts in the battery box must be painted with an acid-resisting compound.

For washing batteries the use of water was discouraged, as it tends to make the negative plates lose their charge. In changing plates from one electrolyte to another the elements should be kept out of the acid as little as possible. One or more cells of a series, showing up weak should be removed from circuit and treated until the normal condition is restored; meanwhile other good cells take the place of the weak cells in the working circuit. A weak cell will quickly go to pieces if continued in service, particularly if the battery is discharged to a low point as the cell may become reversed. In the use of the pilot-cell method great pains must be taken to keep the electrolyte conditions of the group uniform. Other directions for taking care of cells in and out of service were given with some detail, and a complete system of recording tests, cleanings and renewals was recommended to be observed with care.

Interesting from an historical and curious standpoint was the next paper, "Railway Train Lighting," first delivered before the American Institute of Electrical Engineers at Chicago in June, 1892, by A. H. Bauer, the father of W. F. Bauer, a member of the convention. The paper was read before the car lighting engineers by Mr. Bender. A brief abstract of the matters of historical importance contained in the paper is given below:

The first successful system of railway train lighting was that invented by Houghton and adopted by the London, Brighton & South Coast Railway of England, in 1881. Other improvements added by many inventors later made the system almost automatic. Connected by link belting to the car axle, was a Brush dynamo in the baggage car. A ball governor, rotating vertically, performed the following functions: Opened a switch when the electromotive force of the generator fell below that of the battery, adjusted a resistance to maintain the current constant, shifted the brushes to conform to the neutral point at the particular speed of the armature. The pole changer, designed to make the machine pick up in whichever direction the car should run, consisted of a freely moving rocker-arm carrying the brushes and able to be moved through a quadrant by the friction of the brushes on the commutator, at the same time operating a throw-over switch controlling the connection of the field coils. The rocker-arm was brought to position by a snap-spring arrangement. One set of accumulators, consisting of twenty-five cells, was provided for each train and placed in the baggage compartment. The maximum number of lamps in a train was seventy, of ten candlepower each, at fifty volts.

Axle-lighting seemed to have failed in America, the author observed in 1892, since the bogie truck used in this country did not allow a stable arrangement of the pulley, belt and axle, as was possible on the rigid wheel bases of Europe.

In 1887-88 the first attempt was made to use secondary or storage batteries in lighting two Pullman limited trains of six cars each. Each car was equipped with thirty cells, weighing fifty pounds per cell. Duplicate sets were kept charged at each end of the line and exchanged for the exhausted battery on the car. Twenty-six sixteen-candlepower lamps, operating at sixty volts, were used per car. This system failed because the capacity of the battery was too small and the cells were usually exhausted before 11 p. m. Another reason was the deterioration of the plates, which were of the pasted-grid type.

In 1890, four cars, each equipped with thirty-two cells of 150-ampere-hours capacity, and containing twenty-six sixteen-candlepower, sixty-volt lamps, were running between Chicago, Indianapolis and Cincinnati. The cars were charged at one end of the run while standing on a particular sidetrack near the generating station.

In January, 1888, six-car trains between Jersey City, N. J., and Jacksonville, Fla., were lighted by a vertical single-stroke engine, belt-connected to the generator in the baggage car. Steam from the locomotive boiler was used. A three-cylinder engine direct-connected to a seventy-five-volt, sixty-ampere dynamo run at 1,000 revolutions per minute was next installed. However, metallic dirt from the brakes and roadbed formed such frequent short-circuits that an extra armature was always carried and changes sometimes made while the train was in motion. Later the Eickemeyer dynamo, which was of an enclosed construction, was installed with success.

The cost of such a complete installation, with batteries, was figured at $5,808 per train, or $968 per car. "So successful has been the lighting of these trains that it is rare for other sources of illumination to be used," says the author in appreciation of the advantages of electric

lighting. "There is no doubt," he concludes, "that the ideal way of running a dynamo is by connection with the axle. * * * It is, however, thought that within the next year a reliable connection will be had, after which I believe the lighting of railway trains by electricity will be universally adopted."

Following the reading of Mr. Bauer's paper, the convention took up the discussion of storage batteries and was soon engaged in a spirited dissension on the relative value of the rubber jar and the lead-lined tank. The charge made that rubber tended to crystallize and become brittle with age was denied by those who had experienced success with pure and compound rubber jars. Methods of crating and handling, all agreed, had an important part in the resultant breakage during service.

On Tuesday morning an effort was made to crystallize the results of the preceding day's discussion on the relative advantages of the rubber jar and lead-lined tank and the construction of battery trays by obtaining a vote on a resolution embodying the recommendations of the majority of the car-lighting engineers present. A resolution declaring that reinforced rubber jars set in petrolyte or some suitable material are superior to lead-lined tanks failed to pass by a single vote, the convention dividing almost equally over the merits of the respective containers. A unanimous vote was accorded the general resolution to the effect that the materials of which trays are to be made is largely governed by local conditions.

The report of the committee on "Straight Electric Lighting" was then read by C. W. Bender of the Pennsylvania Railroad. J. R. Sloan and A. McGarry were associated with him in the preparation of the paper. The report discussed the necessity for auxiliary methods of lighting trains, except the provision of emergency candles, under the varying conditions met in straight-storage, axle-generator and head-end systems. In the first case the batteries must be of ample capacity, and sufficient time for charging must be given at layover points.

In the committee's opinion the axle generator and steam turbine have been developed to such a point that with competent inspection they will give satisfactory service. The report cited the instance of one railroad operating several hundred electrically lighted cars, these cars being equipped either for straight-storage, axle-generator or head-end system, and on which, with very few exceptions, there is no auxiliary system of lighting other than emergency candles, and the failures of electric lights are gratifyingly small. The majority of those that do occur are on account of insufficient layover time and inadequate charging facilities.

In the general discussion which followed the confidence of the engineers in unreinforced electric lighting was evident and the experiences of the members showed that practice now leans toward straight electrical installations. Sole dependence on the system and a better routing of cars for electrical inspection and repair were shown to make for reliable operation of electrical equipment. The percentage of gas failures, it was concluded, is about equal to the electrical outages observed. Several engineers advised incorporating rules regarding attention to fuses and lights, in the book of train rules for the crew, and requiring examinations.

Some very interesting remarks by two outside visitors enhanced the afternoon session. Wilson E. Symons, who has been prominent in railroad development and maintenance work, attended the meeting and was called to the front of the room, where he read several extracts from a paper delivered before a technical society earlier in the year, apropos the passing of the steam locomotive. After a brief history of electric traction Mr. Symons congratulated the members of the Association of Car Lighting Engineers on the splendid work before them and predicted that as an authoritative body the association would achieve a position only second to the Master Car Builders.

A. H. Darker, of the J. Stone Company, Deptford, England, was next called upon and surprised the convention by his account of the progress of car lighting elsewhere than America. He reported that 30,000 cars equipped with an axle-lighting system were used in the civilized and comparatively unsettled countries of both hemispheres. Potentials of sixteen, twenty-four and sixty volts are common practice abroad. The severe handling in Europe, where cars penetrate half a dozen different countries during the shifting of a week, is an extreme condition which American car-lighting men are not called to meet. Instruction cards must be printed in several different languages. Electrical car-lighting with no auxiliaries has been found absolutely reliable in the extensive practice of Mr. Darker's company.

The report of the committee on train connectors, read by H. C. Milo, one of the committee with A. McGary and J. R. Sloan, involved a technical discussion of a device which, the members' remarks implied, is not yet entirely satisfactory.

E. W. Jensen, chairman of the committee on organization and systemization in connection with electric-lighted trains, followed with the report prepared by himself and his associates of the committee, W. Barnum and F. McGary. The first part of this paper was taken up with a compilation of report forms used in recording materials, renewal and inspection. Several examples were given of the force necessary to handle electrical equipment. For instance, one road has the major portion of its cars equipped for lighting from straight storage battery and its limited trains lighted with a turbine head-end system. At one terminal, ninety cars per day are handled, of which fifty-eight are straight-storage, twenty-four head-end and eight axle-lighted. There is a force of one electrician in charge, one assistant electrician, one clerk for records and correspondence, one storeroom clerk, four electrical machinists for turbine work, axle generator work and general repairs, four yard electricians for testing and charging batteries and twelve batterymen, who make all battery repairs, clean and supply the different sets of battery. At this point the majority of the cars are cleaned and repaired.

Sessions were held on Wednesday and Thursday. The annual banquet was held on Wednesday evening, and the programme called for a jaunt to Milwaukee on Friday.

A number of exhibitors occupied parlors on the convention-hall floor of the Grand Pacific Hotel, and several showed operating installations to claim the attention of the car-lighting engineers between the sessions. Exhibits of the following companies were shown: Consolidated Railway Electric Lighting and Equipment Company, the Willard Storage Battery Company, the Westinghouse Machine Company (storage batteries), Storage Battery Lighting Company, Central Electric Company, Bliss Electric Car Lighting Company, the Safety Car Heating and Lighting Company, the New York Leather Belting Company, the National Electric Lamp Association (engineering department), the Gould Car Coupler Company and the Bijur Battery Company.

Chicago Section—Illuminating Engineering Society.

The second fall meeting of the Chicago Section of the Illuminating Engineering Society was held at the Grand Pacific Hotel on the evening of November 12. After the usual dinner the meeting was devoted to a discussion of some of the papers that had been presented at the recent annual convention of the society at Philadelphia. These papers were recently abstracted in both the ELECTRICAL REVIEW and the WESTERN ELECTRICIAN.

The first paper considered was that of Leonard J. Lewinson on "The Intensity of Natural Illumination Throughout the Day." It was briefly abstracted by Albert Scheible. In the discussion J. R. Cravath gave an explanation of why the author could not read his instruments with an illumination of two foot-candles at dawn. Mr. George H. Jones spoke of the marvelous range of the eye, which can adapt itself with comfort to variations in illuminating intensity from a small fraction of a foot-candle to over 10,000 foot-candles.

A paper by J. R. Cravath and V. R. Lansingh on "The Calculation of Illumination by the Flux of Light Method" was then abstracted with great care by Mr. Cravath. He demonstrated graphically the various steps that led to the development of this method and showed how it can be used. There was no discussion of this subject.

Consideration was then given to the paper presented by V. R. Lansingh and T. W. Rolph on "Some Experiments on Reflection from Ceilings, Walls and Floors." This also was abstracted by Mr. Cravath, who showed a graphic chart prepared from the results given in the paper as to the watts per lumen required to illuminate a working plane in a room having, first, ceiling, walls and floor dark, then the ceiling light, next ceiling and walls light, and finally even the floor light. The discussion on this subject was quite general. Mr. Scheible thought that in the first case the use of a mirror type instead of a prismatic reflector would have shown even more striking a contrast in the figures with and without reflector. It was also pointed out that for the case with floor dark there was little difference between the use of a reflector and not using one. The figures for the last case were said to be now quite commonly attained by the use of tungsten lamps.

The next meeting of this section will probably consider some problems relating to illumination by gas, as its date coincides with the holding of a "Gas Show" that is scheduled for the First Regiment Armory.

New York Section—Illuminating Engineering Society.

The regular monthly meeting of the New York Section of the Illuminating Engineering Society was held on Thursday evening, November 12, at the St. Gabriel's Branch Carnegie Library on East Thirty-sixth Street.

The object of holding the meeting at the library was twofold, one being to give the members an opportunity to examine and discuss the lighting installation, and the second that the designer has the benefits of the discussion in the designs of similar buildings now under construction.

The illumination of the building was designed by the first president of the society, L. B. Marks, and the installation was described with measurements of the illumination in a paper presented at the recent convention at Philadelphia.

The meeting was called to order by Albert Wahle and the installation was described briefly by Mr. Marks. The visitors were quite as numerous as the members, including the chief of the circulation department of the New York public libraries, Mr. Bostwick, and a number of the librarians in charge of the various branches throughout the city.

A feature of the lighting of this building was that it was the first to be erected where local lighting was provided.

Prof. Morgan Brooks of the University of Illinois cited an instance where there was sufficient illumination for reading, but that upon some of the tables reading lamps were provided and the students invariably selected these tables. He thought the reason for this was that it was the attractiveness and coziness, as he expressed it, of a table lamp.

The installation was also discussed by Messrs. Doane, Lansingh, Moore, Barton, Owens, Wahle and Millar.

From the discussion it would be hardly fair to state that this particular type was altogether successful, although none of the members mentioned an installation where only general lighting was provided where results were as satisfactory as in the case under discussion. The members were the guests of the Librarians of the city, and through their hospitality refreshments were enjoyed by all.

More Westinghouse Stock.

A special meeting of the stockholders of the Westinghouse Electric and Manufacturing Company was called on November 11, to meet in Pittsburg on November 24, to provide for the carrying out of the reorganization plan. The stockholders will be asked to increase the board of directors to sixteen and to constitute a proxy committee, to remain in existence five years, according to the requirements of the modified plan of the Readjustment Committee, which is to take the company out of the hands of the receivers.

The stockholders will also be asked to make changes in the by-laws required by the plan and to increase the capital stock by $10,000,000, as well as to adopt the necessary resolutions to make the plan itself effective.

The requirements of the modified plan for the readjustment of the debt of the company will require approximately $14,200,000 of new assenting stock, to be issued to holders of the merchandise debt and bank debt and to stockholders who have subscribed for new stock in cash. Of the present authorized assenting stock of the company $12,500,000 is reserved against the convertible gold bonds and $23,940,000 is issued, leaving only $9,560,000 unissued.

Announcement is made that the Pittsburg banks have raised the $1,500,000 additional cash necessary to make the reorganization plan a success, by taking the notes of the Security Investment Company. The operation of the readjustment plan will give the Westinghouse company a total of approximately $12,000,000 cash.

The inquiries received by the Westinghouse company for electrical apparatus are larger than at any time in years past.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on November 24 for the following electrical material: Miscellaneous cable, 6,000 feet lamp cord, two generator sets, 500 lamp guards, three transformers, 1,000 molded mica sockets, 1,000 porcelain wall receptacles, 11,400 feet weatherproof wire and miscellaneous wire, for delivery at Norfolk, Va.; 20,000 duct-feet vitrified-clay conduit, for delivery at Philadelphia, Pa.; fifty arc lamps and eight knife switches for delivery at Charleston, S. C.; 4,000 incandescent lamps, for delivery at Brooklyn, N. Y.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART VIII.)—POLYPHASE CURRENTS.

DISTINCTION FROM SINGLE-PHASE CURRENTS.

The alternating current heretofore considered is what is known as a single-phase current; that is, the generator delivering an alternating current to a single circuit. In the polyphase system the armature consists of two or more independent windings, each of which is connected through its own transmission lines to separate receiving circuits. Each independent circuit of a polyphase system carries a single-phase current, but these single-phase currents differ in phase, and the combination constitutes a polyphase system. Two such separately generated currents differing in phase constitute a two-phase system; three separate circuits, a three-phase system, and so on.

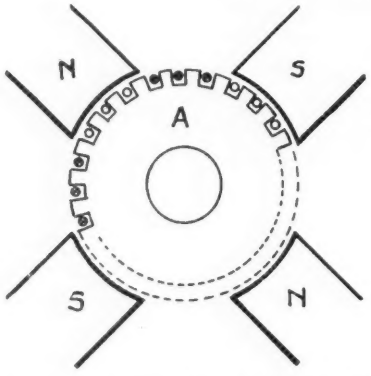


FIG. 19.—IDEAL TWO-PHASE GENERATOR.

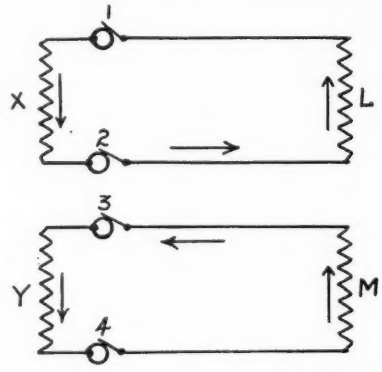


FIG. 20.—CIRCUITS OF TWO-PHASE ALTERNATOR WITH FOUR COLLECTOR RINGS.

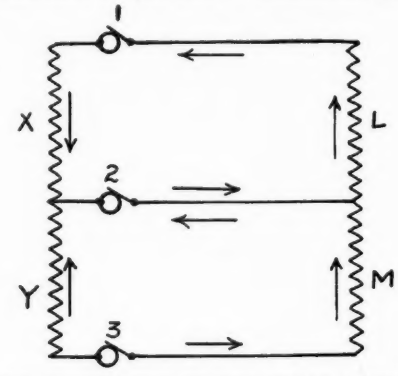


FIG. 21.—CIRCUITS OF TWO-PHASE ALTERNATOR WITH THREE COLLECTOR RINGS.

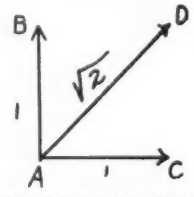


FIG. 22.—RESULTANT OF TWO QUANTITIES ACTING AT RIGHT ANGLES.

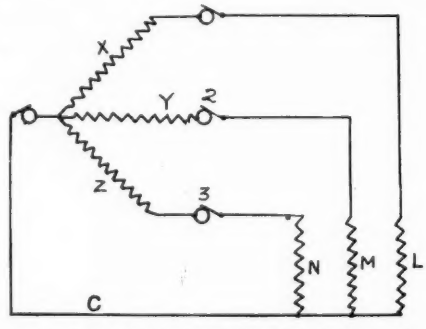


FIG. 23.—CIRCUITS OF THREE-PHASE ALTERNATOR WITH FOUR COLLECTOR RINGS.

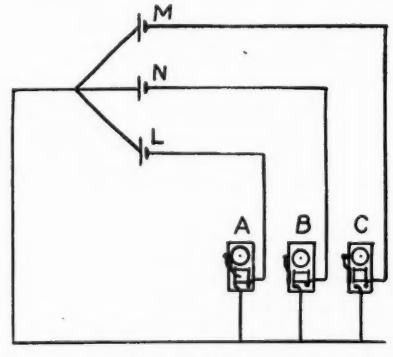


FIG. 24.—ARRANGEMENT OF CALL-BELL CIRCUITS WITH COMMON RETURN.

The principal advantages of this system of generating and transmitting electrical energy are the better operation of motors and the economy secured in transmission. These two reasons for the steady increase in the use of polyphase systems will be considered in more detail under separate headings.

TWO-PHASE SYSTEMS.

In the two-phase system there are two distinct windings on the armature, each with its own collecting rings. They are so arranged that the electromotive force generated in one set of windings is ninety degrees out of phase with that generated in the other set. In other words, one is a maximum where the other is at its zero value. This is more clearly illustrated in Fig. 19. As shown by the projections marked N and S, there are two pairs of pole-pieces. A is the armature containing slots on its periphery, which carry the armature windings. These are in two sets; those marked with a small circle are electrically distinct from those marked with a cross. When one set is directly underneath a pole-piece the other is midway between two poles, and accordingly the electromotive force in one is a maximum when that in the other is zero, as already stated.

A two-phase alternator is usually provided with four collecting rings, as shown in Fig. 20, where X and Y represent the two separate windings of the alternator. Here 1 and 2 represent the collecting rings for the winding X, and 3 and 4 the collecting rings for the winding Y. The arrows show the directions of the current through the circuit while L and M represent the consuming apparatus, such as electric lamps, motors or the like. When used for motors L and M would represent separate windings in the armature of the motor.

THE THREE-WIRE TWO-PHASE SYSTEM.

It is possible to do away with one of the collecting rings by combining the two adjacent conductors of Fig. 20, as shown in Fig. 21. The two currents in the common return wire do not neutralize each other because they are ninety degrees out of phase with each other. The resultant current can be determined just as the resultant of two forces acting at right angles is determined. Thus, as is shown in Fig. 22, AC represents the current from one winding; for example, X and AB the current from the other. These two, differing ninety degrees in phase and being of equal magnitude, give the resultant AD, which is equal to $\sqrt{2}$ AC, or $\sqrt{2}$ AB. In other words, in a balanced load the current in the outside terminals of Fig. 21 being I, that in the common return is $\sqrt{2}$ I. Also, if L is the potential difference between one outside wire and the middle wire of Fig. 21, $\sqrt{2}$ E is the potential difference between the two outside wires.

THE THREE-PHASE SYSTEM.

In some cases it is preferable to use three-phase instead of two-phase current.

This can be arranged by having three separate windings in the armature of the generators connected to six collecting rings, making three distinct circuits and six transmission lines.

In practice, however, it is customary to combine these, as was done in the two-phase system illustrated in Fig. 21. One method of combination is by means of four wires and four collecting rings, as shown in Fig. 23, where the wire C acts as the common return of the others. Here X, Y and Z represent the three separate

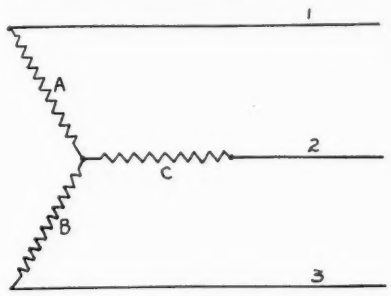


FIG. 25.—THREE-PHASE SYSTEM, STAR CONNECTED.

windings and L, M and N the receiving or consuming circuits, while C is the common return wire. This is similar to three electric-bell circuits having a common return, as shown in Fig. 24. A, B and C are three electric bells, each in a circuit with a battery, as shown at L, N and M respectively, all having a common return.

STAR OR Y CONNECTION.

It is possible to combine the four wires of Fig. 23 in such a manner as to use

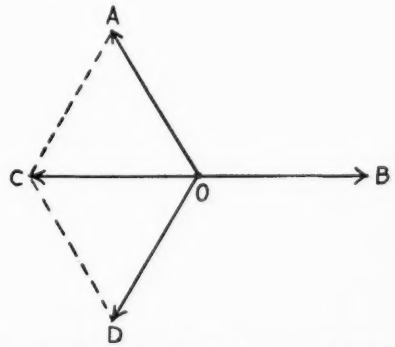


FIG. 26.—PHASE DIAGRAM SHOWING RELATION OF CURRENTS OR VOLTAGES IN A THREE-PHASE SYSTEM.

only three as shown in Fig. 25. The windings are then so arranged that the current flows toward the generator in one coil; for instance, Y, when it is flowing away from the generator in both X and Z. As will be shown by a vector addition of the current quantities, there would then be no use for the conductor C and the coils could be represented by A, B and C of Fig. 25.

The currents in a three-phase system differing 120 degrees in phase can be represented by the lines AO, DO and BO of Fig. 26. If the directions of the three currents at any one instant are as indicated by the arrows, CO, the resultant of AO and DO, is equal and opposite to BO. In other words, the currents in AO and DO exactly balance that in BO and a fourth wire is not necessary. This is called the Y or star method of connecting a three-wire three-phase system.

DELTA CONNECTION.

Another method of connecting the three wires of a three-phase system is known as the mesh or Δ (delta) system. This method is illustrated in Fig. 27. In this case the armature windings form a closed circuit, as shown by A, B and C. Each of the conductors 1, 2 and 3 carries

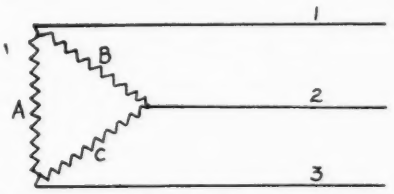


FIG. 27.—THREE-PHASE SYSTEM, DELTA CONNECTED.

currents 120 degrees out of phase with each other, and for this reason one coil does not form a short-circuit for the other two as it would if the currents generated in each coil were all in phase with each other.

Government in Favor of Lower Cable Tolls.

While the Post Office Department is watching with interest the agitation in Great Britain for lower cable tolls between the two countries, it has not yet discovered a way by which it can aid in the movement.

According to the officials, says the New York *Times*, the only way in which the Post Office Department could bring any pressure to bear on the corporations owning the cables would be through the charters granted them by this Government. These charters will be examined, and if it is found that provision is made in the documents for governmental supervision and control, some action may be taken.

Although the Government has not claimed it as a right, the transatlantic cables carry Government messages at special rates. Over the transpacific cable special rates on government business also rule, but these are the result of stipulations embodied in the government charter.

Postmaster-General Meyer is an enthusiastic believer in the establishment of the lowest possible rates on all means of communication between the United States and Europe. The two-cent Postage Convention between England and America entered into recently was framed and executed largely as a result of the Postmaster-General's belief that it would so increase the volume of mail matter that in the end the earnings would be in excess of what they were under the old rate of five cents an ounce.

No comment is made on the proposition of John Henniker Heaton, of London, that the Governments of the United States and Great Britain purchase the cables between the two countries and operate them.

Pittsburg Section of the American Institute of Electrical Engineers.

The regular November meeting of the Pittsburg section of the American Institute of Electrical Engineers was held on November 10, in the Carnegie Institute. W. Edgar Reed, chairman, presided.

Following the informal dinner held at the University Club, the attendance at the meeting was 138. The mining companies and the electrical profession in the entire surrounding district were well represented, including some engineers from the United States Geological Survey.

The subject for the evening was "Electricity in Mines," an original paper, presented by Geo. R. Wood, consulting electrical engineer, of Pittsburg, Pa., who took up the general subject and gave a very complete outline of the application of electricity to coal mining. The lecture was profusely illustrated by lantern slides.

The subject was discussed by F. L. Sessions, of Columbus, Ohio, chief engineer of the Jeffries Manufacturing Company; W. A. Thomas, T. H. Schoepf, J. N. Mahoney and F. C. Albrecht, of the Westinghouse Electric and Manufacturing Company; H. L. Brown, of the General Electric Company, and H. W. Fisher, of the Standard Underground Cable Company.

The subject for the next meeting will be "Some Experiences in the Application of Gas Power in the Operation of Sixty-Cycle Industrial Plants, with Special Reference to the Plant of the Union Switch and Signal Company," an original paper, by J. R. Bibbins, of the Westinghouse Machine Company.

Features of Municipal Lighting in Chicago—Past and Present.

At the meeting of the Chicago Electric Club, held on November 11, William Carroll, City Electrician of Chicago, delivered an interesting address on the features of municipal lighting in Chicago.

For the purpose of making comparisons, early in the year, Mr. Carroll obtained some information about the street lighting of a few American cities, and found at that time, that—

	Arc Lamps.
Chicago had	8,822
Greater New York	14,756
Philadelphia	12,018
Cincinnati	5,651
Boston	3,800
St. Louis	1,150

The annual cost of lighting was:

Chicago	$1,031,542
New York	2,648,546
Philadelphia	1,621,049
Cincinnati	411,704
Boston	805,835
St. Louis	615,960

The costs include gas and gasoline as well as electric.

The cost per square mile was the lowest in Chicago, and the highest in Boston. The cost per candlepower was the lowest in Cincinnati, with Chicago a close second, and St. Louis the highest.

Only two of these cities, New York and Philadelphia, had a greater estimated candlepower than Chicago, and only one, Greater New York, a greater area to be lighted. All maintained gas and gasoline lamps in addition to the electric arcs, New York having over 43,000 gas and 4,300 gasoline lamps. Chicago is behind Boston, Philadelphia and Cincinnati in the candlepower per square mile, but ahead of New York and St. Louis.

This is not a very good showing for Chicago, but not as bad as it might be, but such as it is the bad features exist through no fault of either Mr. Carroll's predecessors or himself. They were and are willing to improve conditions, but have never been able to get sufficient funds to make a complete job. This is an old cry, but a true one. They have been going along, a little at a time, trying to build up an electric-lighting system out of the crumbs dropped from the proceeds of general taxation, when it should have been built at once, he says, out of the proceeds of a bond issue.

The city's electric street-lighting plant was started in the year 1887. At the end of that year there were 104 lamps in service. The power equipment consisted of one 125-horsepower engine, located in the basement of a fire-engine house at the corner of Clinton and Washington streets. In the following year a 300-horsepower engine was added, it being located in a fire-engine house on Jefferson Street, near Van Buren. At the end of the year 1888, there were 279 lamps in service. In the year 1889, a power house was erected on Throop Street, near Van Buren, and the two earlier power stations were abandoned. In the year 1893, the city passed an ordinance requiring that all electric-light extensions must be made by special assessments. This put up to the property owners along each street the proposition that if they wanted electric lights, they must pay for them out of their own pockets. This action appears to have put a damper on the electric-light extensions, as in 1893 there were only ten lamps placed, in 1894 none, and in 1895, eight.

In 1896, the city placed a conduit system and erected lamps on Ogden Avenue, from Madison Street to Twelfth, by special assessment. Some of the property owners along the street refused to pay the assessment, and carried the case into court, where the ordinance was declared unconstitutional, and subsequently disappeared from the Municipal Code.

At the end of the year 1904, seventeen years after the first start was made, there were 5,107 lamps in service. During the next two years 1,909 lamps were placed in service, and in the year 1907, 1,190 lamps were added, there being at the close of that year 8,206 lamps in service.

Up to date in the present year, the city has installed approximately 1,000 additional arc lamps, and the work under way will provide for the addition of 3,000 more; 5,190 lamps in two years of the present administration, more than were added during the first seventeen years of operation.

At the present time there are 9,165 arc lamps operated from the city's circuits. The city is renting 674 lamps from the Commonwealth Edison Company. The rented lamps are located, for the most part, in the southern part of the city, where the city circuits have not been extended.

The cost to the city of Chicago for street lights during the year 1895 was, in round numbers, $1,098,000, and the estimated candlepower 3,964,000. The cost for the year 1907 was $1,031,542 and the estimated candlepower 18,233,000, there being in the last thirteen years a slight reduction in the total cost of street lighting and an increase of about 460 per cent in candlepower.

At the present time the city's streets are lighted by 9,165 municipally-operated arc lamps, 674 rented arc lamps, 10,523 open-flame gas lamps, 12,102 mantle gas lamps, and 7,000 gasoline lamps. At the end of the year we expect to have approximately 12,700 arc lamps in service, including the rented lamps and not including the lights maintained and operated by the Park systems.

The power for the operation of all the city lights is obtained from the Sanitary District of Chicago, the energy being delivered to the city at the District's terminal station on Western Avenue, near Thirty-first Street.

At three of the old stations the city is operating the old direct-current dynamos by synchronous motors, the motors being direct coupled to line shafting and the line shafting belted to the dynamos. From these stations the city is operating approximately 5,000 direct-current open-arc lamps. The steam plants are being held in reserve.

About 4,100 series enclosed, alternating-current arc lamps are being operated through constant-current transformers and automatic regulators. For future extensions to the arc-lighting system, a series of transformer substations have been planned, having a capacity of 1,350 lights each. In each substation there will be three 250-kilovolt-ampere, single-phase transformers, stepping down from 11,500 to 4,200 volts. There will be twenty-seven regulators to operate the same number of fifty-light circuits.

The buildings are to be of brick and reinforced concrete throughout, and absolutely fireproof. Two of these buildings are in process of construction at the present time. One is located on Wood Street, near Nineteenth, and the other on Wentworth Avenue, between Forty-seventh and Forty-eighth. The outside construction work, building of conduits, pulling cables, setting poles, stringing wires and hanging lamps, is nearing completion. The station at Wood and Nineteenth streets will operate all the lamps in the territory bounded by Twelfth Street on the north, the Chicago River on the south and east, and Rockwell Street on the west. From the Wentworth Avenue station there will be operated all the lamps located in the district bounded on the north by Thirty-ninth Street, on the east by Grand Boulevard, on the south by Garfield Boulevard, and on the west

by Halsted Street, the stations being located nearly in the center of the districts lighted.

The circuits will be comparatively short, the longest one containing about four and one-half miles of wire. Some of the older city circuits contained twenty-eight miles of wire.

A similar station, although not so pretentious or expensive, located in the rear of a city bath house on Emerald Avenue near Thirty-fourth Street, was put in operation early in the year. From this station the city is operating 936 lamps. The circuits are all aerial, with iron poles and No. 6 weatherproof, copper wire.

The cost of the completed equipment, building, transformers, regulators, lamps, switchboards, circuits, conduits, cables, transmission lines, etc., was $107,582—nearly $115 per lamp. The lamps operated from the station will cost approximately $38 per lamp per year, including investment charges. This may appear low, but there are no production charges except the $15 per horsepower-year paid the Drainage trustees, and the distribution costs are low, on account of the new and short-circuits, iron poles, etc. The labor is practically confined to lamp trimmers, patrolmen and line repairmen. The total fixed charges for this station are estimated at $11,508.37 per year, making the investment charges about $12.30 per lamp.

In the report on municipal street lighting, recently submitted to the Mayor and City Council by B. J. Arnold and Arthur Young, there is given an estimate of the cost per lamp, with complete alternating-current equipment, and steam plants discarded, of $42.17. It has been estimated that it will take altogether 29,000 arc lamps to properly light the city's streets and alleys. With 12,700 in service at the end of the year, approximately 700 of which will be rented lights, there would remain 17,000 arc lamps to be installed to complete the municipal lighting of the streets and alleys with arc lamps. Assuming that the installation will cost $115 per lamp, there would be a total required of $1,955,000, to which must be added the cost of replacing the existing 5,000 open-arc lamps and equipment, which may be roughly estimated at $70 per lamp, including buildings, transformers, regulators and lamps; so that there is required for the completion of the system approximately $2,305,000.

Assuming that the completed equipment with alternating-current lamps can be operated at $40 per lamp, including investment charges, there is an annual cost of $1,160,000, not much more than the present cost of the street lighting.

The problem now before the city officials is how to raise the $2,305,000, together with money required for other permanent improvements, such as building the new City Hall, building schoolhouses, bridges, police stations, fire-engine houses and other public works, which may be considered as permanent improvements that will benefit posterity, and the cost of which posterity should help to pay.

Annual Report of the Commonwealth Edison Company.

The annual report of the Commonwealth Edison Company for the fiscal year ended September 30, 1908, was issued on November 9. The net earnings, applicable to dividends, were equal to 6.19 per cent on the $30,000,000 of capital stock.

BUSINESS SUMMARY.

Gross income from electric current and merchandise sales	$ 9,500,907
Operating, repairs, and renewals, depreciation, taxes and general expense	6,374,578
Net income from all sources	$ 3,126,329

CHARGES AGAINST INCOME.

Interest on bonds and debentures	$ 1,032,625
Depreciation reserve (Under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Company).	236,000
Dividends paid	1,372,035
	$ 2,640,661
Balance	$ 485,668

ASSETS.

Plants, real estate, etc.	$51,657,050
Unfinished plant investment	318,498
Open accounts	308,598
Material	520,199
Accounts and bills receivable	1,193,933
Cash	1,567,433
Total	$55,565,706

LIABILITIES.

Capital stock		$30,000,000
Bonds and debentures	$21,243,000	
Unsold	500,000	
Sold and outstanding		20,743,000
Real estate mortgages		220,000
Depreciation reserve		1,794,500
Accounts payable		523,768
Municipal compensation		102,477
Taxes accrued		475,000
Bond interest accrued		264,139
Surplus account		1,442,820
Total		$55,565,706

In the annual report, President Samuel Insull calls attention to the following facts:

"In opening the books of account of this company your directors thought it advisable to have made a detailed inventory and valuation of the property and business acquired through the consolidation rather than start with the book values of the constituent companies.

"The making of this inventory and valuation was intrusted to H. M. Byllesby & Co., whose exhaustive report, after an examination extending over a period of six months, has been taken as the basis for the initial-investment entries in the company's books."

The Commonwealth Edison Company came into legal existence and began business on September 17, 1907, through the consolidation of the Chicago Edison Company and the Commonwealth Electric Company, and the net earnings for the period from that date to September 30, 1907, are, for convenience, included in the surplus brought down on September 30, 1907.

The company's connected business, exclusive of electrical energy applied to other public-service corporations, amounted to the equivalent of 4,137,650 standard sixteen-candlepower lamps on September 30, 1908.

The company is also supplying electrical energy amounting to approximately 75,000 horsepower under long-time contracts, running from five to ten years, to street railways and other public-service corporations which have found it to their interest to purchase power.

Electrical Trades Association of Chicago.

The thirteenth annual meeting of the Electrical Trades Association of Chicago will be held in the new banquet hall of the Chicago Athletic Club, at 6:30 p. m., Friday, December 11. The business meeting will be in charge of William A. Browne, president, when reports of officers will be received, and other business that may properly come before the meeting enacted, followed by the election of officers.

The entertainment features will include speeches by B. E. Sunny, president of the Chicago Telephone Company, formerly Chicago manager of the General Electric Company; His Honor William H. McSurely, judge of the Superior Court; His Honor Fred Fake, judge of the Municipal Court of Chicago; the Hon. Charles E. Kremer, of the Chicago bar, and two members of the association, who will speak on association matters from the manufacturer's and jobber's standpoints. Thomas I. Stacey, of the Electric Appliance Company, will be toastmaster. Instrumental and vocal music will be rendered.

Western Society of Engineers.

On November 13 the Electrical Section of the Western Society of Engineers held a meeting in the society's rooms in the Monadnock Block, Chicago, to listen to an illustrated talk on "Recent Developments in Artificial Illuminating Engineering," by W. D'A. Ryan, of Lynn, Mass., illuminationg engineer for the General Electric Company.

In a short preliminary paper Mr. Ryan analyzed the work of the illuminating engineer, and pointed out some of the features discovered in recent illuminating problems. The designing engineer must take account of all factors bearing on his problem, both utilitarian and artistic. These factors require different consideration in different cases. In some cases high efficiency is of prime importance. In other cases the artistic effect is of chief value. Considerable attention has been given recently to the lighting of large interiors, particularly department stores, railway depots and large assembly rooms. The tendency is to do away with exposed lights, and such sources will gradually be banished as advance is made in illuminating standards. Where a perfectly white light is desired, such as in the "white" rooms of department stores, the tungsten lamp has given good results, but these are not to be classed with the success that can be attained in perfect color matching when arc lamps with diffusing globes are used. The requisites for this service are both whiteness and high intensity of illumination. The latter should approximate about two watts per square foot of floor surface. The tungsten lamp has achieved remarkable results in recent illuminating work and bids fair to take the place of even the arc lamp for many kinds of lighting.

After this Mr. Ryan showed scores of lantern slides illustrating recent advances in light sources and some good installations. He described the particular points of each type illustrated, and pointed out many interesting features in connection therewith. First, there were shown a large number of photometric curves of tungsten lamps as modified by the various forms of reflectors, shades, frosting, etc. Quite a number of views of pendent tungstoliers were shown with and without reflecting shades and varying from plain to very ornate designs comprising rich metal work and art glass. A number of chandeliers were shown ranging from simple designs to one for church lighting that was valued at $3,400.

Arc lamps with spherical enclosing globes of a large number of types were shown. Also one type having a parabolic reflector directly above the arc. This lamp is a new design and is in a class between the miniature and enclosed types. Its efficiency is said to be one watt per lower hemispherical candlepower. This lamp was particularly designed to have a perfect white light. The tungsten lamp is not nearly as white a source and, therefore, not so good for perfect color matching; however, in nine cases out of ten, Mr. Ryan said, the tungsten lamp gives more pleasing effects in the display of goods.

A variety of ceiling bowls with various types of globes and diffusers were shown. These were particularly adapted for use with tungsten lamps. An installation of this kind designed for the galleries of the Philadelphia Art Club was shown with a continuous row of these diffusers in the form of a large rectangle, which distributed the light very uniformly over the walls and left the center of the room in a subdued light.

A view of the New York Post Office was shown, in which the lighting is entirely by projecting arc diffusers. These Mr. Ryan does not regard as very pleasing in appearance, but very effective in light distribution.

The Washington Union Depot illuminating installation was shown in a number of views, particularly of the famous waiting room, which is one of the best examples of indirect lighting now in existence. Details of the lighting equipment in the coves were shown. There were also views in other waiting rooms, of the concourse and of the exterior. The Schenectady Depot was illustrated also.

The portable luximeter designed by Mr. Ryan was shown and briefly described. It is entirely self-contained, being equipped with all the instruments necessary and made up in a very compact form. It is intended for rapid and accurate determinations of illumination from zero to twelve-foot-candle intensities.

A number of views of a large machine shop showing the lighting as carried out by different systems were displayed, also a striking view of the Singer Tower in New York, which was the first building illuminated with projectors.

The lighting of Niagara Falls with several batteries of projectors was illustrated with a large number of very good views and described in considerable detail.

At the conclusion of Mr. Ryan's interesting talk the discussion was opened by James Lyman, who asked about the standard used in the luximeter. A standardized tungsten lamp is used for this purpose, said Mr. Ryan, as he gave further details about the use of the instrument.

A question by Chairman D. W. Roper elicited a reply that about 500 horsepower is used in the Niagara Falls illumination. This power is derived from the electrical plants at the falls. Prof. E. H. Freeman asked about the new white arc lamp that had been shown. Mr. Ryan described its construction further and showed how the use of small carbons increased the efficiency a great deal.

Mr. Lyman asked whether the tungsten lamp is going to reduce the use of arc lamps for interior illumination. To this Mr. Ryan replied that for interior lighting the arc lamp is now practically dead, or rather that it is fast being substituted and is passing out as steadily as the old open arc lamps. For some purposes, however, such as for instance for the lighting of white rooms, as he had already said, the arc lamp will undoubtedly hold its own. Mr. Roper remarked that since the introduction of the tungsten lamps there has been practically no new installation of arc lamps for interior lighting in the experience of his company.

P. Junkersfeld wished to know the watt consumption per square foot in the large waiting room of the Washington Depot. This, Mr. Ryan said, was arranged so that varying intensities of illumination using one, two or three watts per square foot can be used. He also showed by simple test diagrams when indirect cove lighting can be made very efficient and why, when certain features are disregarded, the lighting can be made very inefficient. With a consumption of three watts per square foot in this particular installation they claim an illumination of two foot-candles.

J. R. Cravath declared that indirect lighting has come to the front since efficient illuminants had been produced. A great advance has been made in producing light efficiently and equally great advance in utilizing the light produced. In general, he thinks, that it is highly desirable to confine the light more to the

useful plane, and, therefore, to use reflectors that concentrate the light downward on the working plane without wasting much for side walls. This should hold true even for the lighting of fairly large spaces.

Mr. Ryan concluded the discussion by asserting that wide reflection is best for large interiors because it gives a much more uniform distribution. In fact, if such a thing was feasible, he would prefer to use the reflector giving as wide a distribution as possible. He showed that in lighting of department stores, for instance, where one source was installed per day a wide distribution of the light would not cause an appreciable amount of it to be wasted on side walls. Speaking of indirect lighting, he showed that an intensity of only half as much as with exposed lighting may give as good or even better results because the eye is better adapted to diffused light. Indirect lighting, however, may be carried too far since it produces a rather flat effect, such as we notice on cloudy days. Therefore, he would be in favor of having with the indirect lighting just enough direct lighting to produce a noticeable shadow in one direction so as to give tone to the general illumination effect.

National Sales Managers' Association.

About three weeks ago a half-dozen sales managers met at the Automobile Club, in Chicago, and formed a temporary organization, with C. A. S. Howlett, of the Western Electric Company, as chairman. A meeting was held on November 5, at the Great Northern Hotel, with about sixty-five present, and the National Sales Managers' Association was formed. H. H. Cushman, of L. A. Becker Company, Chicago, was elected president, and John T. Webber, of the Wabash Cabinet Company, Chicago, was elected secretary. Each of the sixty-five men present filed application for membership, and there are now four electrical men members of the organization, with about 100 others who have filed applications, representing some seventy-five different kinds of business. The plans include meeting every Thursday noon for lunch, at which time there will be an address by some prominent member of a sales organization. On November 12 the meeting was addressed by the sales manager of the Burroughs Adding Machine Company.

READY REFERENCES IN CALCULATING GENERAL ILLUMINATION.

BY W. B. BONHAM.

In designing the illumination of a room the use of the following table will be found convenient in determining the total candlepower necessary to produce a predetermined intensity:

Class of Service.	Ft. Candles.	Constant—Dark.	Constant—Walls.	Constant—Light
Reading	2.0	0.50	....	0.40
Theaters	2.0	0.50	....	0.40
Churches	3.5	0.80	....	0.70
General store...	3.5	0.80	....	0.70
Desk illumination	3.5	0.90	....	0.70
Bookkeeping ..	4.0	0.95	....	0.80
Clothing	5.5	1.30	....	1.10
Drafting and engraving	7.0	1.70	....	1.40
Window lighting.	10.0	....	2.50	....

This table is to be used only where the light units are equipped with good reflectors.

The operation of this table gives the total candlepower, regardless of the size or type of light unit. In order to produce a uniform distribution of this light some attention must be given to the location of the units. This will be determined by the design of the rooms. As a general proposition, the lower the ceiling the greater will be the number of units necessary to produce an even distribution of light. The following formula is suggested:

$A \times C =$ total candlepower,

where A = area of floor space in square feet, and C is a constant to be found in the table opposite the class of service which is being considered, choice of the constant depending on the color of the walls in each case. The total candlepower divided by the number of units or clusters to be used gives the candlepower per unit or cluster, or the total candlepower divided by the candlepower of the unit or cluster gives the number of units or clusters necessary.

Example.—A room 70 feet by 120 feet, with light walls, is to be lighted to give good reading illumination. Referring to table (two foot-candles are required); The constant for light walls, 0.40; area equals 70 feet by 120 feet, 8,400 square feet. $8,400 \times 0.40$ equals 3,360 candles. Twelve units (three rows of four units each) have been decided upon; 3,360 divided by 12 equals 280 candles per unit or cluster.

If a unit containing five sixty-watt tungsten lamps had been decided upon, $5 \times 48 = 240$ candles. Then divide 3,360 by 240; equals 14 units.

Total candlepower multiplied by efficiency of lamps (watts-per-candlepower) equals total watts consumed.

If tungsten lamps are used multiply by 1.25; Gem, 2.5, etc.

The Chicago Electric Club.

At the noon-day meeting of the Chicago Electric Club on November 18, Thomas I. Stacey, secretary of the Electric Appliance Company, made an address on "Chicago, the Great Central Market." Mr. Stacey described the organization of the Chicago Association of Commerce, which was the outgrowth of the old Association of Merchants and Travelers. The present association is indebted for its organization, in large measure, to J. B. Compton, who initiated the movement in 1904. The organization has about 3,000 members. The committees include the Chicago River Improvement Committee, the Civic Improvement Committee, the Freight Traffic Committee, the Foreign Trade Committee, the Public Service Committee, the Street Traffic Committee, and the Ways and Means Committee.

To the Street Traffic Committee credit is due for the improvement in traffic conditions which is now being carried out in Chicago. The Freight Traffic Committee has secured improved service and better rates, particularly to that territory where the business interests of Chicago were not being favorably handled. One of the most important endeavors with which the association has been identified was the agitation in favor of the bond issue for building a deep waterway from the Lakes to the Gulf, giving Chicago access to the seaports of the world.

Chairman C. A. S. Howlett announced that at the next meeting of the club an address would be made by Frederic P. Vose on "Contracts."

W. P. Crockett announced that George Searing, one of the charter members of the club, was seriously ill, and it was unanimously voted to bear an expression of sympathy to Mrs. Searing.

New York Electrical Society.

The regular meeting of the New York Electrical Society will be held on November 24, at the Electrical Testing Laboratories, New York city. Dr. Clayton H. Sharp will present an address describing some of the recent developments in photometric methods and apparatus, and there will be a demonstration of the facilities available at the Testing Laboratories.

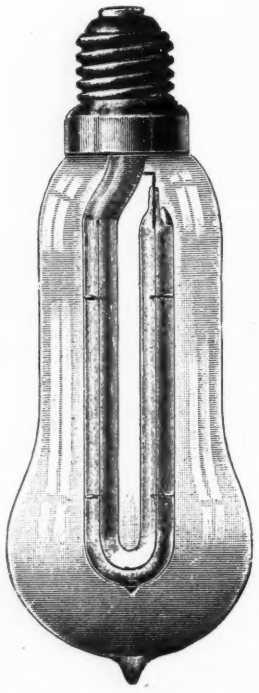
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE WATERPOWER PLANTS OF SWITZERLAND.

The Swiss Electrotechnical Association publishes every year statistics of the electric stations in Switzerland, which are particularly interesting, on account of the fact that over fifty per cent of all the installations are exclusively waterpower plants, while another thirty-six per cent also exploit waterpower and have installed heat motors for reserve or as an addition. According to the statistics for the year 1906, there were 539 works and undertakings engaged in the distribution of electrical energy in Switzerland. Of these, 240 produced all their current by water turbines or heat motors, fifty obtained part of the current from other works, and 249 purchased all the current they distributed from third parties. The purely hydraulic plants supply about 59.8 per cent of the total performance of all the Swiss electric generating stations. Direct current is used by 185 of the power stations, single-phase alternating current by eighty-seven, two-phase current by eleven, and polyphase current by 150. For long-distance transmission direct current with parallel connection is used in ten instances (six per cent), direct current with series connection in seven (four per cent), single-phase alternating current in fifty-three (thirty-two per cent), two-phase current in seven (four per cent), and polyphase current in 143 instances (fifty-five per cent). For lighting, direct current is used in thirty per cent of the cases, single-phase current in thirty-two per cent, two-phase current in one per cent, and polyphase current in thirty-seven per cent of the cases. The tension used in long-distance transmission varies from 1,000 to 25,000 volts for alternating current, and from 5,000 to 25,000 volts for direct current. The periodicity of the current was fifty in seventy-two instances and forty in sixteen instances, the remaining stations using various frequencies. The current-consuming devices connected to all the stations and entitled to simultaneous operation corresponded to a capacity of 161,000 kilowatts. Statistics of the capital invested in the various installations are published this year for the first time. For installations producing their own current the average investment per kilowatt of capacity was 1,080 marks, 560 marks of this sum applying to the hydraulic and caloric parts, and 520 marks to the electrical part. For installations that only purchase and distribute current the average investment per kilowatt of capacity was 460 marks.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 18.*

A NEW CARBON-FILAMENT MERCURY-VAPOR LAMP.

A new lamp has recently been installed by Robert Hopfelt. This lamp is claimed to combine the advantages of the carbon and mercury-vapor lamps, being insensitive to shock like the former and having the economy of the latter. The consumption of energy per candlepower is about sixty per cent less than that of ordinary carbon-filament lamps. The construction of the lamp is as follows: A carbon filament is fused into a U-shaped glass tube, which contains a drop of mercury and an indifferent gas in order to transmit the heat of the filament to the mercury. The U-shaped tube is then fused into a bulb, so that the completed lamp has the appearance of an ordinary incandescent lamp. When the lamp is started the filament at first glows with a consumption of about three watts per candlepower, like an ordinary lamp. As soon as sufficient mercury has been vaporized the light intensity increases more than twofold, so that the lamp consumes about 1.5 to 1.6 watts per candlepower. It requires about five minutes for the light to reach its full intensity, but as the lamps give light from the moment that current is turned on, they may be used for all purposes. The lamps are made for all the usual tensions, and their life under normal conditions is from 600 to 1,000 hours. The light is a pure white and contains no disagreeable green or blue rays.—*Translated and abstracted from Die Umschau (Frankfort a. M.), October 31.*



NEW CARBON-FILAMENT MERCURY-VAPOR LAMP.

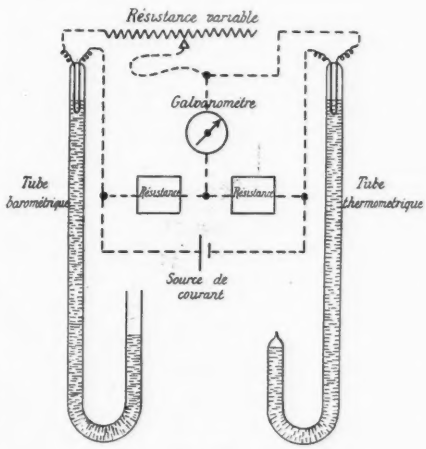
THE MANUFACTURE OF METALLIC LAMP-FILAMENTS.

Ing. B. Duschnitz, in this installment of a serial article on the various methods at present employed for manufacturing metallic lamp-filaments, describes the process employed by the Auer Gesellschaft, of Berlin. The firm uses an entirely new method of preparing hollow filaments of wolfram. The raw filaments, which are themselves neither hollow nor coated with a layer, consist of perfectly homogeneous material which must contain carbon; and, difficult as it may seem, they are transformed into hollow ones. The reduction methods that effect the transformation of these carbon-containing filaments into more or less pure wolfram filaments are already well known. If after one of these processes a carbon-containing wolfram filament is gradually heated and finally brought to white heat in an atmosphere which contains, besides hydrogen, or hydrogen and nitrogen, also minute traces of oxygen, then a wolfram filament is obtained which still contains a little carbon, but is not hollow. It was found that if the temperature of a raw filament through which current is flowing is rapidly raised long before the carbon has been chemically removed from it, a hollow filament is formed. This filament still contains con-

siderable amounts of carbon which may be removed by any of the well-known methods, but the Auer Gesellschaft considers it of advantage to use the filaments directly in the lamps with rather high carbon contents. They are said to possess the advantage of requiring shorter lengths than solid filaments for equal voltages. A hollow filament is stated to be best obtained by placing a filament composed of about ninety-three per cent of wolfram and seven per cent of carbon in an atmosphere containing, besides hydrogen, or hydrogen and nitrogen, minute amounts of water vapor. The filament is then inserted in an electric circuit and the current intensity is allowed to increase rapidly by raising the tension, so that the filament is brought to white heat within a few seconds. The result is a filament which is hollow throughout its entire length. The diameter of the hollow space may be influenced by the rapidity with which the temperature is raised. If the filament is allowed to remain at a low temperature for a considerable length of time before it is brought to white heat, the hollow space will be smaller; it will be larger, if white heat is reached rapidly. The Auer Gesellschaft gives no explanation of this phenomenon, which might also be made use of for other technical purposes. With ordinary reduction methods the carbon particles contained in the raw filament come out from the filament substance only gradually with the progressive heating, and, when they arrive at the outside, are reduced to carbon oxide or carbon dioxide, and the filament substance shrinks together. On the other hand, when the carbon molecules are caused to vaporize by sudden heating, they have no time to escape to the outside, and consequently produce an interior pressure. This pressure, or expansion, of the carbon vapors forces the other filament substance radially outward, thus producing hollow interior spaces. It is possible that the resulting minute pores unite into communicating channels, the less resisting walls of the pores being expanded or broken through. As any escaping carbon is immediately absorbed by the surrounding reducing atmosphere, the filament shrinks together along its circumference; that is, the outside pores are filled by the softened metal immediately after becoming empty. The walls must then naturally become more resisting and impenetrable, and the carbon vapors circulating in the small communicating channels in the interior of the filament tend to increase these channels on account of their expansion at the high temperature of 2,000 degrees, so that after a little time a single longitudinal channel comes into existence. In support of the correctness of this explanation made by the author he cites the fact, that in such carbon-containing filaments hollow spaces may be clearly observed under the microscope, even if the process is interrupted before completion.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 15.*

AN ELECTRIC BAROMETER.

In this barometer, which is described by Robert Goldschmidt, the variations in the height of a mercury column resulting from the changes of atmospheric pressure are caused to modify the resistance of a filament of low specific conductivity in-



ELECTRIC BAROMETER.

serted in an electric circuit. A thin U-shaped carbon filament is fused into the closed end of a barometer tube and its terminals are connected to two binding posts on the outside of the tube. When the tube is filled with mercury, the curved part of the filament is more or less immersed in it, according to the atmospheric pressure to which the mercury column is subjected. The parallel branches of the filament traverse the vacuum of the barometer. The current passing through the two branches of the filament and the mercury meets with more or less resistance, accordingly as the mercury column is higher or lower. It is not sufficient, however, in order to obtain an indication of the changes in atmospheric pressure, to measure the variations of the total resistance of the carbon filament, as temperature changes also influence the level of the mercury column. This cause of error may be eliminated by using a second mercury column in a tube closed at both ends, in which the mercury level is influenced only by temperature changes of the surrounding medium. In this second tube, which operates as a thermometer, a carbon filament is arranged as in the first, and its resistance is modified by changes in the height of the mercury column. Thus, while the changes of resistance in the barometric tube correspond at the same time to variations of atmospheric pressure and temperature, the indications of the thermometric tube relate to temperature changes only. If the resistances composed of the two filaments are arranged in series like two branches of a Wheatstone bridge and compensated by resistances in the lower branch of the same bridge, a galvanometer connected in the usual manner across the bridge will remain at zero, when at an equal atmospheric pressure the temperature causes a change in the height of the mercury in both tubes at the same time. The relation of the compensating resistances will evidently vary according to the thickness of the filaments used in the tubes, their relative dimensions, and the changes of the mercury level produced by the same temperature variation in each tube. In order to indicate the variation of atmospheric pressure it is only necessary to insert in that branch of the bridge containing the thermometric filament, for instance, an adjustable resistance, such as a high-resistance wire mounted over a graduated scale, which, by means of a sliding contact, may be inserted more or less in the circuit. By regulating this resistance so that the galvanometer remains at zero, one adds to or takes from it exactly the same amount of resistance that has been added to or taken from the carbon filament in the barometric tube by variations of atmospheric pressure only. These variations are thus read on the graduated scale of the adjustable resistance. It is easy, by means of the arrangement described, to read variations of one-tenthousandth of a millimeter in the height of the barometric mercury column. Curves obtained by means of this apparatus were found to correspond always with those at the Uccles Observatory.—*Translated and abstracted from Bulletin Mensual, Societe Belge d'Electriciens (Brussels), October.*

The grand total of excavation during the month of October on the Panama Canal was 3,224,638 cubic yards, the highest record for rainy-season excavation, based upon telephone reports from division engineers.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

REMOTE-CONTROL SWITCHES.

BY H. W. YOUNG.

In the construction of the modern building, the architect and engineer are often obliged to spend a great deal of time in determining the best method for the distribution and control of current for light and power service. This perplexity is occasioned by the increase in the use of electrical appliances and an attempt to control them by the usual methods, as the increase in size of conduit and conductor prohibits the location of the switch at the point most desirable for the control of the circuit.

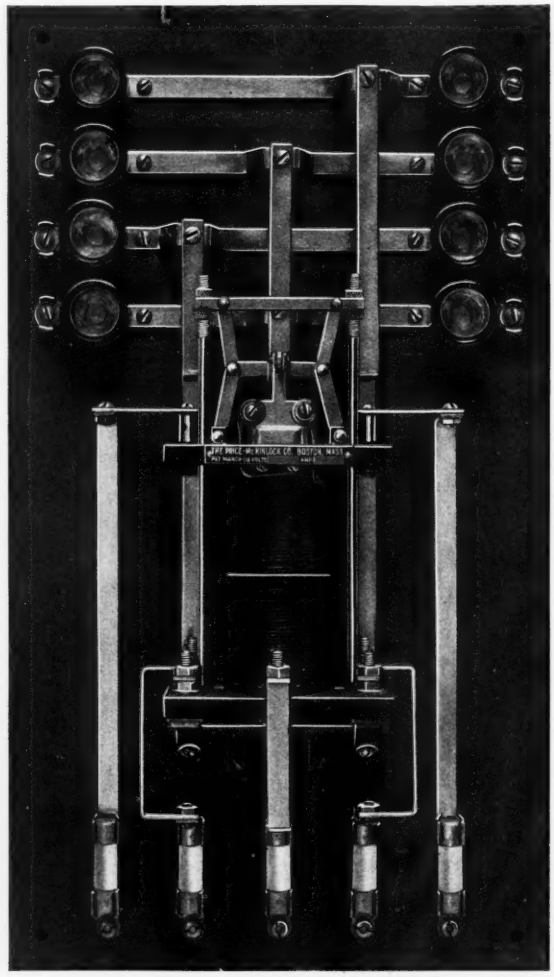
In handling circuits of greater capacity than can be controlled by standard flush switches, it has been customary to locate manual switches in the basements of buildings or in closets or corners not easy of access; and frequently the architect or contractor has been compelled to place switch panels where they marred the decorations of some room. In fact, it has seldom been possible to place these switches where they could be reached without inconvenience, though it is often necessary to use them several times a day for light or motor control.

To meet the conditions mentioned above, the remote-control switch illustrated herewith has been designed with a threefold object in view: First, to simplify the control of current; second, to enable anyone to control lights or motors from various points without making it necessary to bring the service wires to those points; third, to effect a direct saving in first cost of installation and consumption of current.

This switch is a magnetically operated device that can be furnished in practically any capacity, and controlled by momentary-contact switches, located at as many points as desired. It is built along the recognized lines of modern circuit-breaker practice, being provided with laminated contacts and steel toggle mechanism. It has a straight-line motion and cannot be left in a half-closed or half-open position.

It would be difficult to cite an instance of modern building construction in which electricity is to be used as an illuminant or a source of power where the value of remote-control switches would not be so apparent on the ground of either economy, convenience or safety as to warrant their use; and frequently the investigation would show their value to be many times their cost, in a direct saving of copper and conduit, with an indirect saving in current charges.

By the use of remote control it is possible to cut out lights or motors in any part of a building at any time, from any point where a momentary-contact flush push-button can be located. For example: If remote-control switches are located in the basement of a ten-story building which is lighted by electricity, it is possible to arrange on the desk of the superintendent, or anywhere in his office, which office could be located on any floor, a system of flush push-buttons controlling all the lights or any group of lights in the entire building. And it would only be necessary to run No. 14 wires direct to the office from the remote-control switches. Hence, with this switch there is no excuse for wasting current on account of the inconvenience of going to the ordinary switch panel-board. Other applications are obvious.



THE P-M REMOTE-CONTROL SWITCH.

The system of remote control allows the electrical engineer to plan his wire-ways from service entrances to distributing panels without considering the switch outlets; so that the entire building may be supplied by one unbroken feed or its equivalent. This frequently makes it

possible to effect a saving of fifty per cent in copper and conduit over the indirect method of wiring when a switch location is usually a long distance from the natural center of distribution.

In wiring buildings, the remote-control switches are located with reference only to their accessibility and the natural wiring centers; momentary-contact switches are located at the most convenient points from which it is desirable to control the lights, thus avoiding the necessity of either carrying the heavy mains to the switching point or installing the switch in an inconvenient location. These methods of wiring show in every case a saving of copper and conduit, and a convenience of use that reduces lighting charges and fire hazards to a minimum.

The complicated wiring systems in the modern theater may be greatly simplified by the use of remote-control switches, it being possible to so arrange a system of theater wiring as to greatly simplify the stage switchboard, giving better control of lights, and frequently making a considerable saving in the cost of wiring.

TELEPHONE SWITCHBOARD BUILDING IN RECORD-BREAKING TIME.

BY S. E. BROWN.

Commercially speechless — such was practically the condition in which thousands of business men of Paris found themselves on the morning of September 21, 1908. Berlin, which the day before was at their elbows, now lay to the northward distant six hundred miles; London, only a moment's time away twelve hours before, was now across the sea; and the provinces of France which had lain within the shadow of the walls of the capitol now stretched from Alsace-Lorraine to the Pyrenees.

The burning of a single building in Paris—the great Central Telephone Exchange—was what isolated and paralyzed her commercially. The fire of a few hours' duration ate up $6,000,000 of property, took the business district out of a single structure and spread it over a wide area and pushed the city back in history more than twenty years.

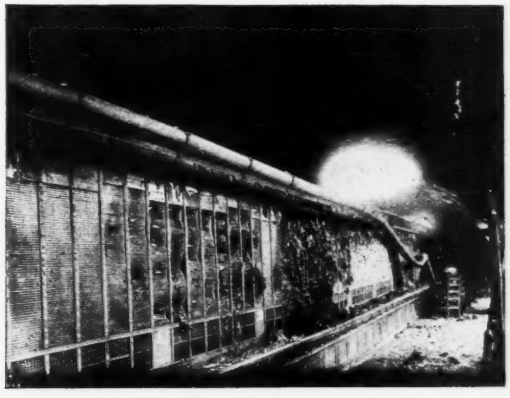
Rob any city of today of its telephone system and it goes back to where it stood before the telephone became a commercial necessity. But what makes the modern city helpless when its telephone equipment is destroyed is that it cannot go back. The reason for this is that the telephone made the modern city possible. Try to imagine New York's skyscraper district without the telephone! When deprived of its use, its value is appreciated.

Business for one day in Paris was carried on by means of what telegraph lines had not been ruined when the telephone building burned, by messenger service, by special conveyance, by each and every method possible that would give a greater speed than mail. The next day saw an emergency telephone equipment caring for crippled business as best it could. Meanwhile hurried conferences were being held by the Paris telephone managers with the Paris representatives of an American manufacturing company relative to an equipment to take the place of that destroyed. For emergency equipments at best are but first aids to the wounded

FRONT VIEW OF SECTION OF NEW WESTERN ELECTRIC PARIS TELEPHONE SWITCHBOARD.

REAR VIEW OF WESTERN ELECTRIC PARIS TELEPHONE SWITCHBOARD LINED UP IN HAWTHORNE SHOPS PRIOR TO SHIPMENT.

PARIS MAIN OFFICE, 9,000-LINE BOARD, THIRD FLOOR, BURNED ON SEPTEMBER 20.



PARIS MAIN OFFICE, 10,000-LINE BOARD, FOURTH FLOOR, BURNED ON SEPTEMBER 20.

and are to be put aside as speedily as possible.

The building of equipment for a telephone exchange the size of the one destroyed requires time, and the people of Paris were clamoring for telephone service. This explains why the managers of the Paris Telephone Company immediately after the fire took their problem up with the largest manufacturers of telephone apparatus in the world. Speed was the controlling factor; speed and quality. So they turned to a company that held the record for both.

The proposition put up to the Paris house of the Western Electric Company was a staggering one, but the Paris house had resources. They themselves had enormous facilities and back of them was the parent house in New York city which in turn was backed by the company's Hawthorne plant just outside the city of Chicago. This last-named plant is the largest telephone manufacturing plant in the world and for it rush orders hold no terrors. When fire eliminated the telephone plant in Rio de Janeiro the cable had wildly called for apparatus. Hawthorne met the demand. Then early in the year Tokyo had called on Hawthorne to build material to take the place of a large shipment for Japan which had been lost when the S. S. Holenfels was destroyed by fire. This work was done in less time than Tokyo demanded.

So when the request from Paris was telegraphed to Hawthorne the men in charge of the telephone manufacture figured coolly and swiftly. They knew what they had done before could be done again. September 22 Paris had the cabled reply that Hawthorne could furnish its part of the equipment complete in less than thirty days.

A diversion was created on September 24 by Paris asking for switchboard cable; a request which terminated a few days later in an order for 135,000 feet. The Western Electric Company, however, had the full amount of the size desired in stock at Hawthorne. Hawthorne was ordered to ship. But shipping cable by steamer differs from shipment by rail. The cable must be fully protected from salt water. Nevertheless, the twenty-five miles of cable was unwound from reels, the ends paraffined, cable rewound on reels, packed in waterproof cases and placed on cars in less than two days after receiving the order.

The most interesting fact brought out by the order, however, was not what the company did but what it could do. The Paris order for cable, as before stated, was made up from stock. The Hawthorne plant offered to turn out twice that amount weekly from raw material.

Meanwhile, the superintendent of the switchboard department at Hawthorne had been having more than a cable order to think about. On September 29 the New York house telephoned to begin work on a switchboard and cheerily informed him that the Paris house had agreed to have the entire installation completed in sixty days, and that a $600 daily penalty was attached to the contract. The information about the switchboard wasn't quite so indefinite as that, but it was pretty hazy. It was all the information New York could give, however, and all the Paris house could furnish, so the man at Hawthorne went as far as he possibly dared on his meager instructions, meanwhile wondering about the sixty days. He clearly understood about the $600 per day.

October 3 brought information which was definite. Already a large amount of material had been lined up and the moment the decisive word from Paris came, men trained to the minute in switchboard building began their tasks. In a trifle over three weeks after a definite order had been given by the managers of the telephone exchange in Paris, the finished switchboard stood at Hawthorne ready for chipment.

Meanwhile the New York agent had not been idle. The result of his efforts showed that express train speed in manufacture is only one of many ways of beating penalty time to the tape.

The same day that complete information was given Hawthorne a request was made for an estimate on the number of carloads and weight of the shipment. Reservation was made on a French Line steamer that sailed on October 29, and arrangements were made with railroads that special attention be given the shipment. It was. The six carloads of material came from Chicago to New York in about two days.

The shipment from Hawthorne together with a large amount of additional material which the New York house had manufactured was shipped to Paris on the French Line steamer La Provence, that sailed from New York on October 29. Thus, only a few days more than a month elapsed from the date the fire occurred in Paris until a completed switchboard from the United States was on the sea. A switchboard, by the way, which stands 180 feet long, requires ninety operators to operate and will accommodate more than 10,000 subscribers. While the back of this switchboard would appear as unintelligible to the layman as a page of Sanskrit, it may be of interest to know that it contains about a million soldered connections and 3,000 miles of wire. It is of some interest also to know that approximately 40,000 feet of lumber were used in packing the completed board, and that 10,000 square feet of paraffine paper was used in the cabling boxes alone.

A Big Shipment of Tungstoliers.

The accompanying illustration shows the way in which a big order for Tungstoliers was recently sent to one of the company's selling agents. This electric-lighting fixture has created a good deal of a stir throughout the entire field, and the

A BIG ORDER OF TUNGSTOLIERS.

company is booking orders which are far in excess of its expectations, although it arranged, in developing these light units, for a demand which marked a new record in supply and demand.

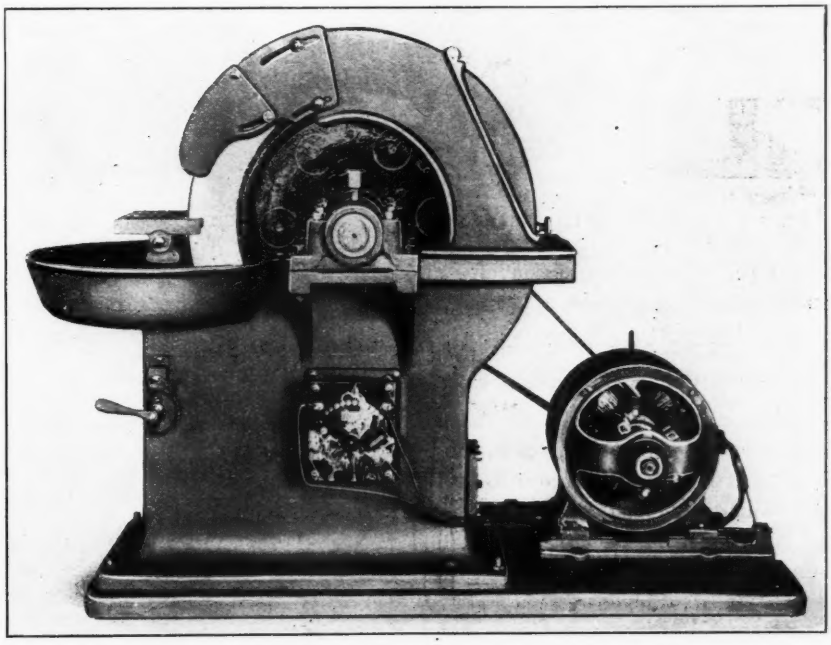
The Phelps Alloy.

Announcement is made of the discovery of the Phelps alloy by the Phelps Manufacturing Company, 54 State Street, Detroit, Mich. This metal fuses at 2,500 degrees Fahrenheit, is positively non-corrosive, and is said to be a reliable substitute for platinum for a great many purposes, such as contacts for electric bells, annunciators, telephones, spark-plugs, gasoline engines and automatic flashers. The cost of this alloy is said to be about one-third that of platinum, and from the tests which have been made it is expected that the metal will give entire satisfaction. Several large telephone companies are now using this material, and repeat orders are evidence of the satisfaction being experienced with it. The Phelps alloy is made in sheets, wires and rivets.

An Electrically Driven Tool Grinder.

Probably the first equipment in a machine shop to be driven by an individual electric motor in experimenting with electricity as a motive power is the tool grinder, because it combines so many of the various advantages of the electric drive. Tools are sharpened only at intervals and the load is fluctuating, permitting the outfit to be shut down between jobs and also taking advantage of any decrease in the demand for power. As a grinder has often to be located somewhat apart from the rest of the machinery, it becomes difficult to make the necessary belt connections where a mechanical transmission system is used. With a small motor supplying the power the grinder may be located at any point that convenience demands and the wires run to it without trouble.

The Safety Emery Wheel Company, of Springfield, Ohio, is supplying a thirty-six-inch by four-inch emery wheel, shown in the illustration, equipped with a standard Westinghouse direct-current, type S, four-horsepower motor. The motor runs at 1,175 revolutions per minute and drives



MOTOR-DRIVEN TOOL GRINDER.

the emery wheel at 450 revolutions per minute. The starting device for the motor is directly on the grinder, providing the most convenient method for bringing the wheel up to speed.

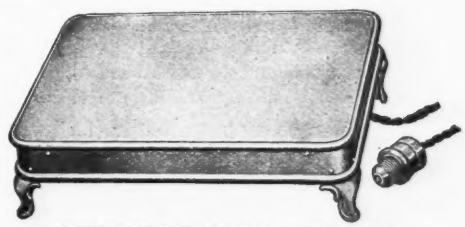
The illustration shows a constant-speed shunt motor, but the use of an adjustable-speed motor is recommended, as the speed may be increased to allow for wear of the emery wheel.

It will be noted that the motor is mounted well out of the way on the extended sub-base of the grinder, and therefore forms a very flexible outfit in that it may be moved as a unit. Two operators can work on the grinder at the same time, as a door provided in the hood in the rear allows grinding to be done there as well as in front. Water is prevented from splashing over the floor or the motor by the wide pan in front and the apron in the rear.

Electric Food Warmers.

Among articles for table service, the heated tray or platter made in plate is an old institution, and came into vogue many generations ago, its object being for keeping hot, ready for a second helping, the roasts and vegetables at dinner. These devices were made, some, with double bottoms for the reception of hot water between the two; others were made arranged with a spirit lamp for providing the heat. Because of the care in keeping these in order for service, they have never been used to anything like the extent they deserved.

The Simplex Electric Heating Company, Cambridge, Mass., has recently put on the market a line of electric food warmers, to take the place of these devices. Instead of applying the heat to a variety of platters or dishes, they provide a heated stand for use in the dining room, on which the food dishes may be set, and where they will be kept warm. They are in attractive design, in nickel or silver plate, having a top surface in dull-finish aluminum, which is not easily scratched or discolored, and the top, with the heater attached, is removable to facilitate the cleaning or polishing of the plated portions. The temperature is limited, so that there



SIMPLEX ELECTRIC FOOD WARMER.

is ample heat for the requirements, and yet not sufficient to endanger the choicest china in being injured. The current consumption is such that most of the sizes can be connected to lamp sockets, and the cost for operation is small.

These food warmers are made in a variety of sizes and designs, both oval and oblong, the top surface varying from 10 by 14 inches in the smaller sizes to 10 by 26 inches in the larger. They are furnished in moderate weights for domestic requirements, and in extra heavy weights for hotel use. The Simplex company reports an immediate demand for these goods both for hotels, restaurants and domestic use. They have supplied them in quantities to such New York hotels as the St. Regis, Hotel Astor, Cafe Martin, and others.

General Electric Orders.

The orders received by the General Electric Company for the third quarter of the year amounted to $10,397,117 and for the nine months of the year to $30,054,924. This compares with orders of $14,581,382 and of $49,677,500 received during the corresponding periods last year.

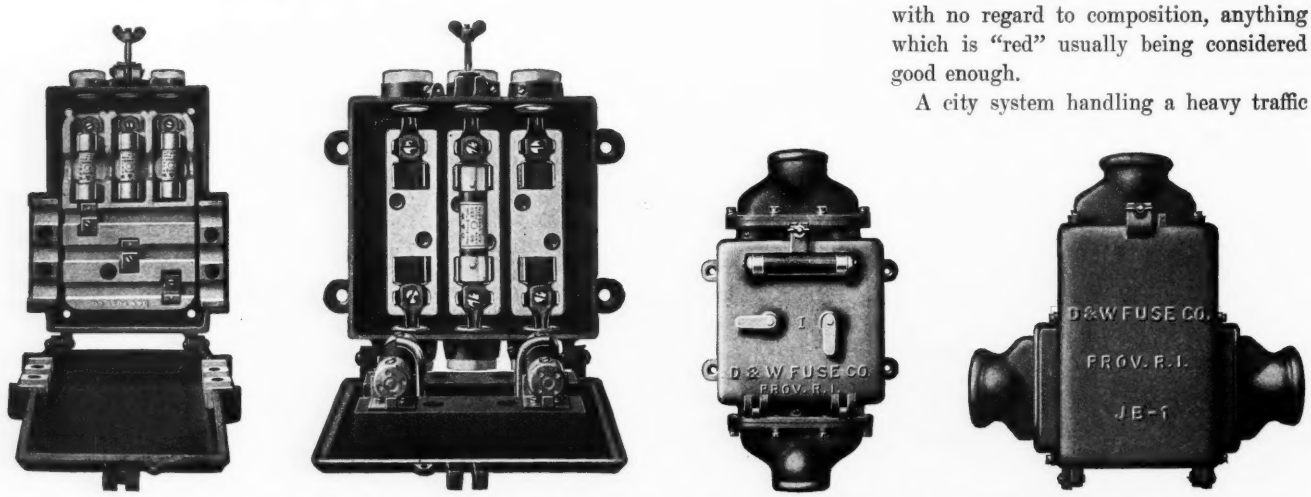
The orders received for the third quarter were smaller than in any year back to 1904, but they were larger than the orders for the third quarter of 1904 by over $2,000,000. The orders for the first nine months this year are larger by over $3,750,000 than the orders for the first nine months of 1904.

The sale of $350,000 worth of Alaska-Yukon-Pacific bonds appears to remove the last obstacle to the success of this enterprise, which is to open on June 1 next.

New Line of Service Switches and Cut-out and Branch Boxes.

The D & W Fuse Company, Providence, R. I., is placing upon the market its new service switches and boxes, which have very materially improved this line. In the casting of the iron, owing to operating its own foundry, the company is able to produce boxes of a much finer grade than it could purchase in the open market. Due to this higher-grade material, these boxes are lighter in weight than the former boxes and have a smooth surface, thereby taking a finer finish when japanned. These boxes are provided with rubber gaskets and removable porcelain bushings, through which the cable terminals may be readily passed. In the covers of the service switches are mounted the fuses being directly mounted in the boxes.

In addition to these cut-outs, the company has also brought out a line of branch boxes in which particular attention is called to the split bushings mounted in the cover, and boxes which permit of the necessary connections without any break in the wiring, thereby greatly reducing the cost of installation. For both of these types of boxes there have been designed a complete line of outlet hoods to be used in connection with the conduit system, covering every possible requirement of connection, namely, straight-away, right or left hand, and back and front. These hoods are firmly screwed to the boxes, fitted with rubber gaskets, if desired, and are interchangeable for any



D & W FUSE COMPANY'S NEW LINE OF SERVICE SWITCHES AND CUT-OUT AND BRANCH BOXES.

fuse guides to positively align the fuses in order that the boxes may be readily closed with the fuses properly engaging in the cut-outs. There are also mounted in these covers withdrawal hooks which by one-quarter turn of the levers on the outside of the cover remove the fuses at will.

Owing to the usual practice of grounding the neutral on a three-wire direct-current system, the box is so designed that the neutral fuse remains permanently in the circuit, thus avoiding any possibility of accidents, due to the fuse being withdrawn. For polyphase circuits where all fuses should be removed, the box is provided with three hooks operated simultaneously by one lever. The fuse boxes are similar in construction to the service switches, but are intended for use only as cut-outs, and therefore no switch mechanism is provided for in the covers, given type, being made to fit any size of conduit within the capacity of the box.

Buying on Chemical Specifications.

Where dimensions, weight, finish and the like may be readily expressed in specifications, it is easy and natural to make them conditions upon which purchases shall be accepted. But where strength, chemical composition, durability and similar factors of ultimate efficiency are of importance, specification of these features is too often omitted.

In every industry some material is being bought on the basis of brand, reputation or even satisfactory experience in its use without the least idea that equal efficiency might be obtained at a lower price with a suitable material whose composition could be specified in advance by the chemist.

The purchasing agent of a large electric railway company was recently buying of a reputable supply house a metal for journal linings which gave good satisfaction. He was paying twenty cents a pound and, in view of the nature of the material, felt that the price was high. A sample was submitted to the Arthur D. Little Laboratory in Boston for analysis. Upon receipt of its report the purchasing agent sent out for bids upon a metal of the composition shown on analysis. A reliable concern at once offered such a metal at six cents per pound. As the amount of metal used in a year was large, the saving by having the same metal made to the formula was well worth obtaining.

Trolley ears are a class of material which the average electric road purchases with no regard to composition, anything which is "red" usually being considered good enough.

A city system handling a heavy traffic where delays cost money recently had considerable trouble by the frequent breaking of ears which they were purchasing of a reputable manufacturer. Two of the ears were sent to the laboratory named above for analysis. The report from this laboratory showed the following compositions:

	1	2
Copper	60.5	78.3
Zinc	38.5	16.5
Lead	0.4	4.4
Iron	0.1	0.2
Tin	....	0.5

The analyses show plainly the cause of the trouble: No. 1 is made of the ordinary 60-40 brass and is not strong enough for such work; No. 2 is evidently made from scrap composition and also fails to have the required strength.

This company is now buying under a strict specification. A sample from every shipment is analyzed and the number of breaks is very materially reduced.

Current Electrical News

CONTINENTAL EUROPE.

PARIS, NOVEMBER 7.—A type of petrol-electric motor car is in use upon one of the shorter railroad lines in Austro-Hungary, drawing trains made up of several trailers. The line is the Arad-Csanad local railroad, which connects a number of the large towns in the region, the most important of which is Szegedin. The present type of motor, adopted after a series of trials, consists of a long motor car of the usual form in which is placed a petrol motor and generator group, the latter furnishing current for the motors on the axles. At first the company adopted a thirty-horsepower car, which was designed especially for suburban use at slower speed. For the main lines it now uses a forty-horsepower car drawing two trailers, and more recently it ordered an eighty-horsepower car. The eighty-horsepower outfit contains a Westinghouse six-cylinder petrol motor, coupled direct to a six-pole generator. The car has two trucks, with a motor mounted upon each.

At Zürich recently I had occasion to examine the new plant which the municipality erected for the purpose of consuming household waste, which is laid out on an extensive scale. The waste is burned in a number of furnaces, using a strong air-draught to aid the combustion. The heat from the furnaces is supplied to a boiler which operates a steam turbine coupled to a generator. This furnishes all the current needed in the establishment for the lighting and for a number of motors, besides supplying several factories near by. The waste-consuming plant consists of a set of Horsfall furnaces. After the combustion there remains a certain amount of clinker and fine ash. The clinker is broken up and sifted, and may be used as gravel, while the ash serves as a fertilizer. In the dynamo room is erected a 150-kilowatt Brown-Boveri steam-turbine set, which furnishes three-phase current at 220 volts.

The ferryboat plying between Guilleboeuf and the opposite bank of the Seine, at a point near the channel coast where the river has a great width, is operated on the petrol-electric method, using a seventy-horsepower De Dion-Bouton petrol motor coupled to a 220-volt generator. This outfit is duplicated. The boat is a side-wheeler, the paddle-wheels being driven by two electric motors, which run at 540 revolutions per minute, the gear reduction enabling the wheels to revolve thirty times per minute. Ordinarily a single generator group is sufficient to supply all of the power needed, but in case the tides, which are strongly felt here, should make it necessary, the two groups can be coupled in parallel.

A hydro-electric plant of somewhat novel construction is located in the Rhone valley not far from Lake Leman. It utilizes the water of the celebrated Pissevache Fall, whose stream springs out of the side of the mountain and falls 220 feet into the valley, thus forming one of the most picturesque falls in the county. The electric plant is placed high up in the mountain side and lies above the mouth of the fall. It only uses the water in a gorge before it reaches the fall, and the water is then returned to the cascade in order that the latter will not be impaired. The turbine house is cut in the solid rock and is a chamber of elliptical section, containing the turbo-generator outfit. At present there are six principal groups installed. Two of these are used to furnish direct current at 800 volts for the Martigny-Chamonix railroad, while four of the machines supply 5,000-volt alternating current for use in a neighboring electric furnace plant. The remaining alternator also works at 5,000 volts, supplying current for lighting some of the towns in the vicinity. The water supply is taken at a point lying farther up the gorge, and in this way a head of water of 1,600 feet is obtained. The turbine plant lies at a height of at least 300 feet above the level of the valley. A. DE C.

GREAT BRITAIN.

LONDON, NOVEMBER 6.—There seems to be quite a craze at present among local authorities to go in for the trackless-trolley system, either instead of tramways, or in outlying districts, thus using this mode of traction as a feeder to the main tramway system. The Highways Committee of the London County Council, however, made a proposition this week to use the system in quite another direction. The Council is faced with the position of having its northern and southern tramway systems broken off, so to speak, by the river at Rotherhite and Blackwall by two tunnels which are incapable of holding a double line of fixed tramways. The Highways Committee, which realizes the advantages of linking up both the northern and the southern systems wherever possible, thought to overcome the difficulty by the use of trolley omnibuses in these two tunnels. How far such a policy was desirable from the point of view of the passengers, they having to make two changes in a very short distance, is another matter, but the County Council at its meeting on Tuesday vetoed the suggestion on the ground that sufficient information as to the capabilities of the system are not yet available.

Following the annual meeting of the Victoria Falls Power Company come some inquiries in Parliament as to the rights of the company to the concession for the use of the Falls water. It appears that this is given in an agreement between the British South Africa Company and the African Concessions Syndicate, which is the parent company of the Victoria Falls Power Company.

It is evident the Government intends that the London County Council shall secure control of the whole of the electric-supply arrangements of the metropolis in the future. Following the instruction to the committee which is now dealing with the bulk supply scheme to insert the name of the County Council as the purchasing authority, a similar instruction has been given with regard to the bills of the existing companies, which confer certain additional powers upon them. The question now arises what is to be done with the electrical undertakings of the London borough councils. If these are not also made purchasable by the Council, we shall have the anomalous position of the Council, when it purchases the bulk and the other companies, competing with the borough councils, the capital for whose undertakings the County Council has had to sanction and find. Presumably the committee will deal with this aspect of the case.

The Institution of Civil Engineers has just issued its list of awards for papers read during the past session, and I notice that the only paper dealing with an electrical subject which has been granted an award is that by W. Barclay Parsons on "The New York Rapid Transit Subway."

An experiment in street lighting is being carried out in Leeds, arc lamps and gas lamps being placed side by side for competitive purposes. G.

EASTERN CANADA.

OTTAWA, NOVEMBER 14.—The annual convention of the Canadian Street Railway Association, whose members include all the leading street railways of the Dominion, was in session here during the past week.

One of the most extensive industrial plants in Montreal is the Northern Electric and Manufacturing Company. It employs 1,300 persons, and its market is almost exclusively in Canada. This plant is equipped with the most modern machinery and will be operated entirely by electricity, the power being supplied by a 300-kilowatt Westinghouse-Parsons steam turbine.

It is a matter of note that Montreal consumes more electrically transmitted waterpower than any other city in the

world. This power is drawn from three large generating stations located on the rivers St. Lawrence, Richelieu and St. Maurice, at distances ranging up to eighty-five miles from the central substation in the city of Montreal, while a fourth large hydroelectric plant, which derives its power from the Soulanges Canal, has just been completed. With this chain of electric plants, supported by steam stations at various points in the city, the reliability of electric supply in Montreal is assured beyond any doubt.

Canada is most fortunate in possessing as much available waterpower as any country in the world. Some idea of the supply of power that can be generated in the Dominion may be had from the fact that, it is estimated, the St. Lawrence River alone can supply over 10,000,000 horsepower. There is represented also over 1,000,000 horsepower in the falls and rapids within a radius of fifty miles from the city of Ottawa, and what is true of eastern Canada applies equally to the Lake Superior and western portions of the Dominion.

It is stated that private individuals in the town of Coaticook, Quebec, are contemplating the formation of a company and taking over the town's electric-light plant. As the town is now facing a serious problem, in the way of increased power, a proposition for purchase will probably receive favorable consideration of a majority of the rate payers.

During the week, the first unit of electric power, from the Soulanges Canal, was brought into the city of Montreal and distributed through the city over the wires of the Montreal Light, Heat and Power Company. Since purchasing the charter for the utilization of this power from M. P. Davis of Ottawa, the Montreal company has been at work on the development, which is now completed, and at a cost of $1,500,000 the company has secured a supply of 15,000 horsepower. The work included the construction of a canal connecting the Soulanges Canal, about thirty miles from Montreal, with the St. Lawrence River, a distance of about 2,800 feet. The new canal holds 75,000,000 gallons of water and is 268 feet wide from bank to bank, 232 feet at the water line, 160 feet at the bottom and eighteen feet deep. A forty-foot roadway connects the dam and the power house, and the latter is fireproof, being built of concrete, with iron and glass windows. The six gates, connecting the Soulanges Canal with the new cut, are operated either by hand or by electricity. As the Montreal Light, Heat and Power Company has, at present, contracts which call for the supply of 70,000 horsepower, and has only 65,000 horsepower available, the company has under consideration the construction of a steam plant to provide 10,000 horsepower additional. This steam plant will be completed unit by unit, but the whole will be in operation within the next two years. The disposition of the available power will then be as follows: Lachine, 15,000 horsepower; Chambly, 20,000 horsepower; Shawiniga, 20,000 horsepower, and Soulanges, 15,000 horsepower; total, 70,000 horsepower. W.

WESTERN CANADA.

WINNIPEG, NOVEMBER 14.—The postal authorities at Edmonton, Alb., have approached the civic authorities with a view to having the new electric street railway system used for postal purposes. It is understood an agreement has been arrived at to this end and freight cars will also be operated as soon as possible.

At the meeting of the Canadian Street Railwaymen's Association held in Ottawa on November 12 it was decided to hold the next convention in Winnipeg.

The Canadian Northern Railway Telegraph Company has opened telegraph offices in the following places: Lavelle, Ont.; Lena, Myrtle, Vassar and Russell, Man., and Borden, Sask. It is understood this company will soon negotiate for connections with the States.

The incorporators of the Kootenay Telephones, Ltd., which has a capital of $200,000, and head office at Cranbrook, B. C., are announced to be: Dr. J. H. King, W. F. Gurd, James Ryan, V. Hyde Baker, A. Leitch and R. E. Beattie. The company has already secured the plant and lines of the Cranbrook Light, Heat & Telephone Company and has secured a franchise in Fernie, B. C., to construct a telephone system. The aims of the company are to construct long distance and local telephone systems throughout the Crows Nest Pass country and to connect with the system of the Alberta government, thus giving Winnipeg, connection with the Kootenays.

At Cannington Manor, Saskatchewan, a rural telephone company is being formed. Estimates show the system can be constructed for $35 per mile with one telephone to the mile. The telephone act of Saskatchewan provides for the formation of these rural companies and places the value of the shares at $25 apiece, no person being allowed to hold more than one share.

The ownership and operation of the street railway system at Port Arthur, Ont., is in a curious tangle. The system was built by Port Arthur in 1893 and extended through the sister city of Fort William. Until the present time Port Arthur has owned and operated this system, but recently some of the aldermen from both cities met in Toronto and arranged for the sale to Fort William of that portion of the system running in Fort William. No vote was put to the people and consequently when the time for handing over the portion of the line to Fort William arrived the Port Arthur commission refused to give it up to the joint commission which had been appointed to operate the system. The Ontario Railway and Municipal board was appealed to and issued instructions to the sheriff to seize the system and hand it over to the joint commission. An injunction prevented the sheriff from acting, and mass meetings, attended by virtually every ratepayer in Port Arthur, are being held to protest against the deal. The matter will come up in the courts in the near future, and petitions have been mailed to the Hon. J. M. Gibson, lieutenant-governor of Ontario, Sir James Whitney, premier of Ontario, and various other bodies of influence. At the present time two sets of officials are supposed to be drawing salaries for managing the system. R.

IMPORTANT DEVELOPMENTS.

CLEVELAND TRACTION LINES PUT IN HANDS OF RECEIVERS—Judge Tayler of the Federal court has appointed Warren Bicknell and Frank A. Scott as joint receivers for the Municipal Traction Company and the Cleveland Railway Company. Each of the receivers will furnish a bond of $100,000. Warren Bicknell is president of the Havana Electric Company, which controls all the street railways in Havana, Cuba, and is identified with large numbers of electric traction companies in Ohio and other states. Frank A. Scott is secretary and treasurer of the Superior Savings and Trust Company of Cleveland. The receivers will take charge of the traction system at once, and will operate it under the direct supervision of the court. The rate of fare, it is said, will be as low as can be made consistent with good service.

AUTOMATIC TELEPHONE DILEMMA—Samuel McRoberts, president of the Illinois Tunnel Company, has appeared before the Chicago City Council committee on gas, oil and electric light in the interest of the petition of his company for an extension of two years in which to obtain the required 20,000 telephone subscribers. The franchise of the company provides that that number of telephones must be in operation by next February, or, according to an opinion given by Assistant Corporation Counsel Emil C. Wetten, the city can take over the telephone properties of the corporation, operating the system itself or disposing of the franchise to any other company, as it sees fit. At present the tunnel company has about 5,000 of the automatic telephones in operation. Mr. Roberts said his company could install these telephones before next February, "not in a sensible or business-like way, but to preserve its rights if necessary." He declared that the company is not going to forfeit the franchise, as there is too much property involved.

GREAT FALLS POWER AND TOWNSITE COMPANY TO SPEND $5,000,000 ON POWER PLANT—John D. Ryan, who with associates has purchased the Great Falls Power and Townsite Company, announces that they are about to begin the expenditure of $5,000,000 in building dams and a power plant, and that the construction of a power transmission line, 165 miles long, will soon be begun. This line will run into Butte, Mont.,

and give power for the Butte mines. The company will also build a wire factory at Great Falls and make wire from Butte copper with which it will supply the entire copper wire market from the Missouri River to the Pacific Coast, and will operate plate-glass, carbide and cement factories in connection with the power company.

MONTREAL LIGHT, HEAT AND POWER—The Montreal Light, Heat and Power Company has made arrangements to secure 100,000 additional horsepower in the next two years. Besides securing power from the new Soulanger plant a new large steam plant will be secured.

BOSTON & NORTHERN AND OLD COLONY ROADS TO ISSUE NEW STOCK—The Massachusetts Railroad Commissioners have granted the petition of the Boston & Northern and Old Colony Street Railway Companies, Boston, Mass., for authority to issue $1,096,300 capital stock at 110. The new stock is six per cent preferred, and the distribution is $723,600 Boston & Northern, and $372,700 Old Colony. The proceeds will be used to pay off floating obligations of these companies, the amount of which, in hands of the public, is about $2,500,000.

TELEPHONE MERGER DECLARED OFF—The big telephone deal by which it was proposed to lease the property of the United States (or long-distance) Telephone Company, the Cuyahoga Telephone Company and the Columbus Citizens' Telephone Company to a holding company for 999 years, has been declared off. The negotiations to transfer the properties to the holding company had been going on for weeks and the directors of each company had recommended to the stockholders that the lease be made. Announcement that the proposed deal had failed was made by President Brailey, of the Cuyahoga Telephone Company, following a meeting of the directors.

ENGINEERING SOCIETIES.

TOLEDO SECTION, A. I. E. E.—The Toledo Section of the American Institute of Electrical Engineers held a meeting on November 6 to hear the reading of a paper on "The Westinghouse Nernst Lamp; the Value of Its High Efficiency and Improved Mechanical Construction to Modern Methods of Illumination," by A. E. Eustice. The paper was illustrated with about eighty lantern slides, showing various lamp units, their construction and characteristics, as well as commercial installations equipped with them.

STEVENS ENGINEERING SOCIETY—The Engineering Society of Stevens Institute of Technology, Hoboken, N. J., has published its programme of activities for the season of 1908-09. This includes general lectures, special lectures, inspection trips, and some information concerning the Engineering Society Employment Bureau. Lectures will be delivered by President Alexander C. Humphreys, Arthur G. Glasgow, Calvin W. Rice, W. J. Armstrong, Ferdinand Stark, G. L. Fowler, A. C. Triaca and Frederick K. Vreeland, in the general lecture course. Special lectures will be delivered by Prof. Louis A. Martin, Prof. Albert F. Ganz, Prof. Frank L. Sevenoak, Prof. John C. Ostrup, Prof. George V. Wendell, Prof. Francis J. Pond and Prof. Franklin de R. Furman.

DATES AHEAD.

National Society for the Promotion of Industrial Education. Annual meeting, Atlanta, Ga., November 19-21.

International Independent Telephone Association. Annual convention, Chicago, Ill., December 1-3.

American Society of Mechanical Engineers. Annual meeting, New York city, December 1-4.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

PERSONAL MENTION.

MR. WILLIAM MARCONI, it is unofficially announced, is to receive the next Nobel prize in physics.

PROF. J. ROY ARMSTRONG, of Colorado College, has been commissioned by the City Council of Colorado Springs, Colo., to test the city street arc lamps.

MR. RICHARD O. HEINRICH, director of the European Weston Electrical Instrument Company, Berlin, Germany, is making an extended visit to this country.

MR. G. R. FOLDS has resigned as general manager of the West Penn Railways Company, Pittsburg, Pa., and will become general sales agent and assistant to the president of the H. W. Johns-Manville Company of New York, N. Y.

MR. C. H. SPOTTS, formerly manager of the paint department, and Mr. Walter F. Swearer, assistant at the general offices of the Joseph Dixon Crucible Company, Jersey City, N. J., are now associated with the Protectus Company. Mr. Spotts is secretary, and Mr. Swearer New York manager.

MR. J. R. GORDON, for many years southern district manager for the Westinghouse Electric and Manufacturing Company, has resigned from that company and accepted a position with the Western Electric Company, as power apparatus sales manager for its southern territory, with headquarters at Atlanta, Ga. He took charge of his new duties November 1.

MR HOMER E. NIESZ, manager of the Electrical Trades Exposition Company, Chicago, who has been indisposed for some little time, left Chicago November 16 for Hot Springs, Ark. Mr. Niesz will return to Chicago about the first of December, and it is hoped will then be prepared for the arduous work which the coming Chicago Electrical Show will require of him.

MR. FRANK J. SPRAGUE, of New York, passed through Chicago last week on his way to the Pacific Coast, where he is supervising the installation of a number of electric plants. While in Chicago he inspected the terminal facilities of the Illinois Central Railroad, and made a preliminary study of its traffic conditions as bearing on the electrification project.

MR. T. H. CEPERLEY has been appointed chief engineer of the Stuyvesant Falls power plant of the Albany & Hudson Railroad, to succeed W. G. Andrews. Mr. Ceperley was formerly chief engineer of the Newburgh Light, Heat and Power Company, having charge of plants at both Poughkeepsie and Newburgh.

MR. THEODORE N. VAIL, president of the American Telephone and Telegraph Company, was a passenger on the St. Louis, which sailed for Europe last Saturday. Mr. Vail said: "I shall take up no business while away. I am leaving at this time because there are no business matters in the way and no pressing problems for me to consider. The American Telephone and Telegraph Company has a clear outlook ahead, and I feel that I can go away for a two months' rest."

MR. WALTER ROBBINS, assistant general manager of the Wagner Electric Manufacturing Company, St. Louis, Mo., received, the other day, a postcard from A. W. Wyckoff, the Wagner company's genial Pittsburg representative, portraying the palatial residence of S. R. Dresser, at Bradford, Pa. A three-and-one-half-horsepower Wagner motor runs a vacuum cleaner in this residence, and the postcard bore the following legend: "This is the kind of a power house we always insist on having built around a Wagner three-and-one-half-horsepower motor; larger sizes are built in proportion."

MR. RICHARD C. McLAURIN, Professor of Physics in Columbia University, was elected on November 11 to the presidency of Massachusetts Institute of Technology made vacant by the resignation of Dr. Henry S. Pritchett, a year ago. Professor McLaurin has accepted, and will be inaugurated as soon as he can sever his connection with Columbia. The new president was born in Edinburgh thirty-eight years ago. He spent his boyhood in New Zealand, returning to England to complete a course at Cambridge, where he was graduated with high honors in law. He was afterward professor in the University of New Zealand, and later studied at McGill and Columbia, devoting himself to mathematics and physics.

ELECTRIC LIGHTING.

DALLAS, TEX.—E. A. Worden and others have applied for an electric-light and heating franchise.

ARTESIA, N. M.—Oscar A. Coates of Bisbee, Ariz., has been granted a franchise for an electric-light plant.

CUERO, TEX.—The Cuero Light and Power Company has been incorporated with a capital stock of $100,000.

SUPERIOR, WIS.—The Northwestern Lighting Company has been incorporated with a capital stock of $15,000.

DETROIT, MICH.—The Manufacturers' Light and Power Company, of Detroit, has been incorporated with a capital stock of $10,000.

WALLA WALLA, WASH.—The Washington-Oregon Traction Company has been granted a franchise for an electric light and power plant.

REEDSBURG, WIS.—A day circuit is to be established on the city electric power lines. An expenditure of $8,000 is contemplated in making the change.

CLIFTON SPRINGS, N. Y.—Richmond P. Pratt, of Clifton Springs, and E. VerPlank, of Manchester, who recently purchased the Manchester Mills, have formed the Manchester Power Company.

MISSOULA, MONT.—The Missoula Light and Water Company is planning to add to the capacity of its Missoula plant to meet the growing demand for electric service throughout the territory served.

IOWA CITY, IOWA.—The lighting committee of the city council has recommended asking for bids for 130 magnetite arcs. Bids are also asked for 250 incandescents in addition to the magnetite arcs.

KANSAS CITY, MO.—The Union Finance Company, of Kansas City, Mo., has applied for a fifty-year franchise to supply light in St. Louis County. It is proposed to supply it at twelve-and-one-half cents per killowatt-hour.

TAXCO, MEXICO—An electric power and lighting plant has been installed near Taxco, state of Guerrero, by the Compania Minera y Metalurgica. The power will be used to operate the machinery of the mines of the company.

ROGERSVILLE TENN.—The electric-light plant at Rogersville was destroyed by fire October 29, with a loss of $5,000, partially covered by insurance. The plant will be rebuilt at once, and is promised to be completed by December 15.

NEW CUMBERLAND, W. VA.—The Panhandle Electric Company, with principal office at Pittsburg, Pa., and chief works at New Cumberland, has been chartered with a capital stock of $25,000. One of the incorporators is J. L. Merrill, of Pittsburg.

ELLWOOD CITY, PA.—The City Council has decided to advertise for bids for installing an electric plant in Ellwood City. The people of the town favor a municipally-owned plant. The estimates of the cost of installing a plant have been from $11,000 to $13,500.

GUADALAJARA, MEXICO—George Mitchell and D. B. Russell, of New York, are preparing to install a hydro-electric plant near Guadalajara, to operate the machinery of a marble quarry which they own. They also expect to build an electric railway from their property to Guadalajara.

CHEYENNE, WYO.—The Citizens' Water and Power Company has been incorporated with the object of generating, distributing and selling electricity for light, power and heat in Laramie County, Wyoming, and in Colorado. The directors elected for the first year are George Bullock, G. A. Taff, F. M. McMahon, R. L. Holland and R. S. Ellison.

KEOKUK, IOWA.—The stock and franchise of the Keokuk & Hamilton Water Power Company has been transferred to financial interests which are expected to develop the waterpower of the Des Moines rapids. Fifteen million dollars will be required to develop 200,000 horsepower, and actual work must be begun by February 9, 1910.

CEDAR RAPIDS, IA.—W. G. Dows and Isaac B. Smith, of the Cedar Rapids & Iowa City Railway & Light Company, have purchased waterpower rights in the Cedar River at the Palisades, six miles below Cedar Rapids. A twenty-foot dam will be built, and it is estimated that 50,000 horsepower will be developed. Ultimately there will be an electric line to the Palisades and Mount Vernon.

CUERNAVACA, MEXICO—E. Conas, of Cuernavaca, treasurer of the state of Morelos, is erecting an electric power and lighting plant of 1,600 horsepower capacity at Cuernavaca. Mr. Conas also owns the street-railway system of that city and the power of his plant will be used to operate its cars. It will also furnish power and lights for the town. The plant will be finished about January 1.

GOSHEN, IND.—By a ruling of the Circuit Court the city of Goshen is prevented from rebuilding its commercial lighting system, at a cost of $40,000. The contract had been awarded to the Ironton Engine Company, of Ironton, Ohio. Taxpayers obtained an injunction on the grounds that the 2 per cent legal limit of indebtedness had been exceeded and that error was committed in not advertising for competitive bids.

McKINNEY, TEX.—At the regular meeting of the city council it was decided to purchase material for the extension of the city electric light system, a number of additional arc lights to be put up over the city. The material is to be purchased at once and the work of making the extension will soon be in progress. W. E. McKinnon of Dallas was elected superintendent of the city waterworks and electric light system.

NORTH ADAMS, MASS.—Plans for the building of a new electric-light plant to cost more than $100,00 have been formulated by the North Adams Gas Light Company. The accident of last summer, when a large flywheel burst, is partly responsible in determining the building of the new plant. The new station will have a complete equipment and the capacity will be practically doubled, from 2,500 horsepower to 4,000 horsepower.

ST. LOUIS, MO.—A meeting of business men and property owners in the district bounded by Fourth, Twelfth and Market streets and Washington Avenue, has been held to lay plans for the better and more uniform lighting of the down-town section of the city, especially in the district named. The meeting was under the auspices of the Lighting Committee of the Civic League, which includes J. L. Van Ornum, E. L. Andreon, Joseph D. Bascom, T. F. Chaplin, A. S. Langsdorf and John J. Lichter.

MEXICO CITY, MEXICO—The following applications have been made to the Mexican government recently for concessions to install hydro-electric plants: Mariano Alcerreca and Jose Jijar y Harro to erect a plant on the Santa Cruz and San Francisco creeks, near El Monte; Guillermo Brockman, to erect a plant on the Turbio River, state of Guanajuato; Tezuitlan Mining and Smelting Company, to erect a plant on the Sola River, state of Oaxaca; Isidro Medina, to erect a plant on the Ameca River, near Ameca, state of Jalisco; General Mariano Ruiz, to erect a plant on the Alica River, territory of Tepic; Gill S. Peyton, to erect a plant on the Lerma River, state of Jalisco; Armado I. Santa Cruz, to erect a plant on the Huitzilapam River, state of Puebla.

NOBLESVILLE, IND.—Work is progressing rapidly on the hydraulic dam which the White River Light and Power Company is building across White River, two miles north of Noblesville, and the company hopes to have the plant completed and in operation within the next sixty days. The dam is 300 feet long and develops a head of eighteen feet. The company expects to furnish Noblesville with electricity, and hopes to branch out and supply Cicero, Atlanta and Arcadia and possibly reach as far as Tipton, Lebanon, Frankfort and Elwood. Wallace Campbell, of Anderson, who is promoting an interurban line from Anderson through Noblesville to Lebanon and Crawfordsville, is negotiating with the company for power to operate the road. Mr. Campbell expects to finish the line between Anderson and Noblesville within the next year and he has asked the company for prices for sufficient power to operate the road between these two points.

PROPOSALS.

STREET LIGHTING, TAMPA, FLA.—Sealed bids will be received at the office of the city clerk until November 27 for lighting the streets of the city of Tampa with one hundred or more electric arc lights. Specifications may be had on application to the city clerk.

POST OFFICE AT COLDWATER, MICH.—The office of the Supervising Architect, Treasury Department, Washington, D. C., will receive sealed proposals until December 22 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the post office at Coldwater, Mich., in accordance with specifications, which may be obtained from the custodian of the site at Coldwater or at the office of the supervising architect.

GOVERNMENT BUILDINGS AT ALASKA-YUKON-PACIFIC EXPOSITION, SEATTLE, WASH.—The office of the Supervising Architect, Treasury Department, Washington, D. C., will receive sealed proposals until December 21 for the construction of the United States government buildings at the Alaska-Yukon-Pacific Exposition at Seattle, Wash., in accordance with specifications, which may be obtained from the custodian of the Federal Building at Seattle, the superintendent of construction at the post office at Tacoma, Wash., or at the office of the supervising architect.

NEW PUBLICATIONS.

THE GOLDEN GATE—A very interesting brochure has been published by Adolph M. Schwarz, attorney and counselor-at-law, 299 Broadway, New York, N. Y., describing the beauties of San Francisco, Cal. Mr. Schwarz has established a chain of offices in several of the large commercial centers. It is his opinion, after traveling a great deal throughout the country, that at the Golden Gate there is the grandest opportunity for really enjoying one's work, and living.

NEW MANUFACTURING COMPANIES.

CHICAGO, ILL.—The Grand Flaming Arc Lamp Company has been capitalized at $10,000 to deal in appliances for electric lighting and heating. A. J. Lester, J. D. Ferguson and L. M. Greenlaw are the incorporators.

EDUCATIONAL.

The University of Michigan has accepted plans for an addition to the new engineering building, to be built at a cost of $75,063.75. An appropriation of $1,100 was also made for the construction of a new engineering camp at Douglas Lake.

ELECTRICAL SECURITIES.

Further breadth and activity developed in the bull campaign in last week's stock markets, with dealings more comprehensive and of a higher average than for some time. New high levels in various industrials were made for the year. Commission firms report great interest on the part of the public, and there has been large buying in this direction. The bulk of the trade is reported from western communities, which indicates the wider range of prosperity in this section than anywhere else in the country. The refusal of the United States Circuit Court of Appeals of the application for a rehearing of the Standard Oil decision was regarded favorably, and offset the unfavorable effect of the decision declaring the American Tobacco Company illegal and in restraint of trade under the Sherman Anti-Trust law. This case will be appealed by the company, and is expected to drag along for some time. There has been no lack of reports fostering increased interest, and aside entirely from speculative buying there has been a difficulty in meeting a considerable investment demand. The $20,000,000 bond issue distributed by the Illinois Central was successful beyond the expectations of the most sanguine, and the announcement of the new New York city $12,500,000 bond issue at 4 per cent is regarded as a significant indication of the better values which are now placed on these investments. Money, both call and time, ruled a little higher, and this is what has been expected and generally forecasted. It is the opinion of those best informed, however, that there will be no shortage of money, except possibly a temporary flurry near the end-of-the-year settlements. Reports continue to show the generally improved conditions of business, although there are those who do not hesitate to say that these reports are exaggerated. Railroad earnings, however, continue to show a considerable betterment, and in many well-placed lines there is no doubt whatever of a large and likely-to-be-maintained improvement.

Dividends have been declared upon the following electrical securities: Kings County Electric Light and Power Company; regular quarterly dividend of two per cent, payable December 1. American Railways Company; regular quarterly dividend of one and one-half per cent, payable December 15 to stock of record November 28, books close November 28 and reopen December 3. Grand Rapids Railway Company; regular quarterly dividend on the common stock of one per cent, payable December 1 to stock of record November 15. Chicago Railways Company, a dividend of $4 per share from accrued income to August 1, payable November 15 to stock of record November 12. Philadelphia Electric Company; semi-annual dividend of three per cent, payable December 15 to stock of record November 21. This is an increase of one per cent per annum, putting the stock on a six per cent basis.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 14.

New York:	*Closing.*
Allis-Chalmers common	13⅝
Allis-Chalmers preferred	47⅝
Brooklyn Rapid Transit	55⅞
Consolidated Gas	149½
General Electric	156½
Interborough-Metropolitan common	13¾
Interborough-Metropolitan preferred	35¾
Kings County Electric	128
Mackay Companies (Postal Telegraph and Cables) common	76¼
Mackay Companies (Postal Telegraph and Cables) preferred	70½
Manhattan Elevated	144
Metropolitan Street Railway	31½
New York & New Jersey Telephone	119
Western Union	64½
Westinghouse Mfg. Company	91¼

At the annual meeting of the Manhattan Railway Company Dumont Clarke was elected a director to fill the place of G. P. Morosini, deceased, and Frank J. Gould was elected a director to fill a vacancy. The old officers and the members of the executive committee were re-elected.

Boston:	*Closing.*
American Telephone and Telegraph	131¾
Edison Electric Illuminating	250
Massachusetts Electric	57¾
New England Telephone	124½
Western Telephone and Telegraph pref	70
Philadelphia:	*Closing.*
Electric Company of America	10⅝
Electric Storage Battery common	39½
Electric Storage Battery preferred	39½
Philadelphia Electric	12
Philadelphia Rapid Transit	23
United Gas Improvement	88½
Chicago:	*Closing.*
Chicago Telephone	.....
Commonwealth Edison	108¼
Metropolitan Elevated preferred	.....
National Carbon common	85
National Carbon preferred	104

Following the annual meeting of the Commonwealth-Edison Company, officers were re-elected.

It is semi-officially stated that an extra dividend on Chicago City Railway stock will be declared before the end of the present fiscal year, making a total of nine per cent for the year. The consolidation of the City Railway and Chicago Railways properties is discussed by controlling interests, but it is thought that nothing will be done until Chicago Railways has cleared its deck of various legal entanglements.

South Side Elevated advanced eight points last week. A director states that the company has a substantial cash surplus. The policy of the directors on dividends at the meeting the last of the month will be governed by future increased traffic prospects.

ELECTRIC RAILWAYS.

SAND POINT, IDA.—V. M. Smith has made application for a franchise for a street railway.

McKINNEY, TEX.—The proposed Mineral Wells & Northern Electric Railway is to be extended through Decatur and Denton to McKinney.

BELLEFONTAINE, O.—The line of the Ohio Electric Railroad, from Lakeview to Lima, has been completed and turned over by the contractors.

TOLEDO, OHIO—Construction work on the Lima-Toledo branch of the Ohio Electric Railway system is nearly completed. All of the heavy grading and filling have been finished.

MARSHALL, TEX.—The City Council has granted a franchise to M. Turney and associates to build and operate an electric car line and to furnish lights and power for a period of twenty-five years.

HUNTSVILLE, ALA.—An electric railway company is running a survey to Monte Sano, with the purpose of finding the most available route from the city to the top of the mountain. A railway to the mountain is planned for future construction.

NASHVILLE, TENN.—President H. H. Mayberry, of the Nashville Interurban Railway, makes the announcement that track laying for the road will begin at once and the work will be pushed to a rapid conclusion.

TORREON, MEXICO—A syndicate of wealthy Chinamen are building an electric railway system in Torreon and an interurban line that will connect the city with the town of Matamoros. The system will have about twenty miles of track. The syndicate are operating under the name of the Compania Bancaria y de Tranvias Wah Yick.

KANSAS CITY, MO.—A proposed interurban electric line, to pass through Bonner Springs, Turner and other small towns west of Kansas City, and to connect with the Metropolitan at Argentine, is being talked of by the farmers along the proposed route and the residents of the towns through which it will pass. The farmers say they will grant a right-of-way and are also willing to take stock in a company if formed.

RICHMOND, VA.—A charter has been granted to the Richmond, Urbanna & Peninsular Railway Company, whose president is John C. Robertson of Chesterfield. The capital stock of the company is placed at from $100,000 to $300,000. The proposed new line is to connect with the present electric line at Ashland and will run from West Point to Urbanna, a distance of sixteen miles, through a thickly populated section.

WASHINGTON, PA.—Work has begun on the construction of an interurban trolley line from Monongahela to Washington. Some time ago a franchise was granted the Monongahela and Carroll Street Railway Company to build its line in Monongahela. The company has filed extensions and is now authorized to construct its line from Monongahela to Washington, including a branch beginning near Ellsworths and to run to Marianna.

SEATTLE, WASH.—Within thirty days the Milwaukee road will be running trains between the Columbia River and the western portal of the St. Paul tunnel in St. Paul pass in the Bitter Root mountains. The tunnel through the Bitter Root mountains is 8,750 feet long. One end is in Montana, the other in Idaho. There are fifteen spans in the bridge over the Columbia, and the piers are being built and the steel framework is being pushed rapidly out over the stream.

WINSTON-SALEM, N. C.—A project of some magnitude is announced by Dr. H. P. McKnight, lessee of Vade Mecum Springs, Stokes county, about thirty-two miles from Winston-Salem, who says he will within thirty days start a force of men to work on building an electric car line from the Twin City to the springs. Later, he declares, he will continue the line to Spray and Leaksville, provided the rights-of-way can be secured. Dr. McKnight has surveyors already on the right-of-way which he has obtained.

CHICAGO, ILL.—The Chicago and Oak Park Elevated Railway will have a 155-foot viaduct erected on its main line on Lake street, between Clinton and Canal streets. This will be necessary to secure adequate headroom below its structure for the eight-track approach that the Chicago and Northwestern Railway will build into its new $20,000,000 terminal station. The approaches of the elevated structure have been raised already to an increased height of six feet at the point where the viaduct will be erected.

CHICAGO, ILL.—An innovation in traction management, consisting of an attempt to prevent overcrowding before it begins, has been introduced by the Northwestern Elevated Railroad, in connection with its new "stub" station at North Clark and North Water streets. The trains running into this station will not cross the river. Twenty-five thousand postcards, asking patrons of the road whether they intend to avail themselves of the new accommodations, are being distributed at all stations. The replies will govern the number of trains per day.

GARDEN CITY, KAN.—Work has been commenced on the electric road to be built by the Kansas & Colorado Electrical Transmission Company, which also proposes to build power plants to furnish electrical power for industrial plants in the Arkansas valley west of Garden City. The railroad line is to run from Canon City, Colo., to Dodge City, Kan., with a branch line from Garden City to Scott, Kan., in all 387 miles. The entire survey has been made and grading is completed in Colorado for a distance of about twelve miles northeast of Pueblo.

CHICAGO, ILL.—Since the directors of the Illinois Central Railroad announced that the Chicago terminal is to be electrified, commuters of the Burlington are agitating electrification of the Burlington between Downers Grove and Chicago. With the exception of the Illinois Central and the Chicago & Northwestern the Burlington has the heaviest suburban passenger business of any railroad entering Chicago, and as the company's right-of-way passes through almost the heart of the business district there have been many complaints about the smoke from the trains.

BUFFALO, N. Y.—At the annual meeting of the stockholders of the International Traction Company Nelson Robinson was elected a director, succeeding J. F. Slocum; other directors were re-elected. Subsequently the directors held their business meeting and appointed an executive committee of T. E. Mitten, Nelson Robinson and Thomas Penny. J. W. Crawford was elected secretary, to succeed J. F. Slocum. Thomas Penny, who was elected by the old board about a month ago, succeeding Henry J. Pierce, resigning president, was elected president again by the new directors.

EAST ST. LOUIS, ILL.—In order to forestall a threatened attempt of the East St. Louis and Suburban Railway Company to resume the collection of a ten-cent passenger fare between the Belleville Public Square and Edgemont, the present western terminus at Belleville, the Belleville City Council has passed an ordinance providing a penalty of not over $200 for each offense in collecting more than five cents for a single street-car ride in the city limits. An additional provision of the ordinance is that a transfer given from one line to another within the city limits shall be good for one hour after its issuance.

SAN FRANCISCO, CAL.—The new power plant of the United Railroads of San Francisco at North Beach, on which the company has been working for several months past, is now nearly complete. The new turbo-generator equipment will be capable of producing 5,000 kilowatts, supplying about 140 additional cars. The United Railroads at present get a large proportion of their current from the California Gas and Electric Company and the City Electric Company, and depend upon the latter concerns to such an extent that any interruption of their service seriously interferes with the operation of the cars. While outside power will continue to be employed almost as largely as at present, the new equipment will enable the United Railroads to give constant service regardless of any accident that is likely to occur to the machinery of either of the other companies.

TELEPHONE AND TELEGRAPH.

HOLLAND, TEX.—The Rural Telephone Company has been incorporated with a capital of $400.

BLUEFIELD, W. VA.—The Graham Telephone Company has elected the following officers: President, R. L. Gillespie; secretary and treasurer, P. J. Ritter; general manager, Dr. Carl Greever, of Tazewell.

OAKVILLE, TEX.—A. J. Moore of San Antonio, owner of the Eureka telephone system, has bought the lines and equipment of the rural telephone system, formerly belonging to E. J. Atchley, and is preparing to overhaul the property.

NORFOLK, VA.—The Common Council of Norfolk is considering the proposed merging of the two local telephone companies. The industrial commission, which has devoted considerable time to hearing all sides of the proposed merger, is expected to make a recommendation to the council.

LINCOLN, NEB.—The Nebraska-Iowa Long Distance Telephone Company has been incorporated with a capital of $1,600,000 by F. J. Day, G. O. Beno, E. H. Merriam, F. R. Davis, H. B. Jennings, F. H. Keys, T. G. Turner, W. H. Kimball and C. A. Laubach. $1,000,000 of the stock will be common, and to this stock alone will voting power be accorded.

CHESANING, MICH.—Local business men have organized a home telephone company and have now a paid-in capital of $10,000. C. O. Trask of Saginaw, organizer of the Valley Company in that city, prepared plans and gave other assistance in the organization of the Home concern. The exchange is to be equipped with the latest devices for good service, and will accommodate 250 subscribers.

SANDY HOOK, N. J.—Officers of the Signal Corps are experimenting with a long-distance wireless telephone between the Sandy Hook proving ground and New York city. Heretofore the longest distance covered by a wireless telephone has been between eight and ten miles, but it is claimed that the wireless apparatus now being experimented with will operate over a distance of forty miles.

CHICAGO, ILL.—The Illinois Tunnel Company, which operates an automatic telephone exchange in the downtown district of Chicago, in connection with its freight tunnels, has appealed to the city council for a grant of two years' extension of its telephone franchise. The company declares that, owing to the energy concentrated in pushing the freight and tunnel business, the development of the telephone exchange had been prevented, and only 5,000 of the 25,000 telephones stipulated to be installed at this time have been subscribed for so far.

SEATTLE, WASH.—The signal service wireless stations in Alaska have made another record, removing all doubt as to the feasibility of sending wireless messages overland. Fort Gibbon, several hundred miles inland, is receiving messages from Nome and St. Michael, 500 miles distant, with many ranges of hills between the two stations. A message sent by the steamer Northwestern 1,100 miles west of Cape Flattery to the United Wireless station at Cordova was copied. The message traveled about 1,200 miles in an air line over two ranges of mountains, capped with snow.

CHIHUAHUA, MEX.—The Intermountain and Mining Telephone Company of Chihuahua has adopted plans for the building of the largest long-distance telephone system in Mexico. It recently completed its first 100 miles of telephone line connecting the principal mines in the Guaronapeta mining district. In addition to this completed line the company is preparing to build a system of lines radiating out of Casas Grandes, connecting all of the principal mines within a radius of 100 miles with that town. From Casas Grandes a long-distance line will be built to El Paso, Tex., a distance of about 165 miles. Another line will be built from Guaronapeta to Madeira, where it will connect with the long-distance telephone system owned and operated by the American syndicate, which has established a large lumber business in the mountains of that part of the state. The plans call for the building of more than 500 miles of long-distance lines.

INDUSTRIAL ITEMS.

THE PACIFIC ELECTRIC HEATING COMPANY, whose main office and factory is at Ontario, Cal., has removed its Chicago factory to 63 and 65 West Washington Street.

THE BAILEY-WRIGHT COMPANY, Cleveland, Ohio, announces its incorporation as a general advertising agency, with offices in the Citizens' Building. George J. Bailey and Harland J. Wright compose the firm.

THE AMERICAN CONDUIT COMPANY, 140 Nassau Street, New York, has mailed to its friends a picture postcard showing the method of hauling its bituminized fiber conduit to the trench in Belgium by means of dog carts.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has published a catalogue devoted to a description of the P-M remote-control switch for direct and alternating currents. Copies of this catalogue will be furnished upon request.

THE NERNST LAMP COMPANY, Pittsburg, Pa., in its monthly house journal, *Lux*, for November illustrates some new installations of Nernst lamps under a variety of conditions, which show the useful applications of this popular illuminant.

THE BY-PRODUCTS FUEL COMPANY'S engineering department requests catalogues relating to mining machinery and equipment, power plants, coke ovens, and machine tools. The department may be addressed at Moundsville, W. Va.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new folder describing its Type B knife switches, which conform to the National Electric Code standard. A complete list is given of the various ampere capacities, possible combinations and prices. This circular will be sent upon request.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, has opened an office and battery depot at 1876 Broadway, corner Sixty-second Street, New York city. At this place all kinds of batteries and parts will be kept in stock. Orders for batteries and parts for New York and vicinity will be assembled at this depot, which will insure prompt service and quick deliveries.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in bulletin No. 5532, gives a graphic description, with illustrations, of Victor flaming arc lamps. These lamps have been utilized to great advantage in a number of difficult installations, and the treatment given in the bulletin will afford considerable information to those desiring knowledge on this subject. Copies will be furnished upon request.

H. M. BYLLESBY & COMPANY, Chicago, announce the declaration of the usual quarterly dividend upon the preferred stock of the Mobile Electric Company, of Mobile, Ala., of 1½ per cent, payable November 16 to stockholders of record November 9. The preferred stock books of the company, both in New York and Chicago, are closed from November 9 to the opening of business, November 16.

THE OSWEGO MACHINE WORKS, Oswego, N. Y., extends an invitation through Niel Gray, Jr., its proprietor, to visit its new Chicago and New York salesrooms, where its most recent power and hand-driven paper-cutting machines are shown running with all the latest improvements. The New York store is located at 203 Wooster Street, and the local office, 150 Nassau Street, is in charge of W. S. Timmis, manager. The Chicago store and office is at 347 Dearborn Street, J. M. Ives, manager.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in its bulletin No. 109, just issued, describes small generating sets consisting of Crocker-Wheeler generators and Type D engines made by the U. S. Rapid Fire Gun & Powder Company, and ranging from two to nineteen kilowatts, which are used to advantage for complete small lighting plants. The design of the generators is described in Crocker-Wheeler bulletin No. 100. Direct-current switchboard panels manufactured by the same company, and illustrated in bulletin No. 106, may be assembled to form a switchboard of any size and capacity. The bulletin contains suggestions as to the instruments and apparatus necessary on switchboards. General direct-current information and formulas

for calculating the voltage drop in any feeder, the size of generator and engine required for lighting and power plants and a table of resistance and carrying capacity of wires are given in bulletin No. 107, which also describes the Crocker-Wheeler line of direct-current lighting and power generators of large sizes.

ROBERT W. HUNT & COMPANY, consulting and inspecting engineers, 1121 The Rookery, Chicago, Ill., have been awarded, by the Chicago & Northwestern Railroad Company, the inspection of the structural materials entering into its new terminal station, of which the steel will amount to about 24,000 tons. The same company has also been given the inspection of the steel to be used in the new Blackstone Hotel, now being erected at the corner of Michigan Avenue and Hubbard Court, Chicago.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has developed a compact resistance unit, having the Edison base, and suitable for mounting in a lamp socket. The head of each porcelain tube is arranged with a recess in which a small brass number-plate is inserted, on which the resistance is marked. The tube has a capacity of fifty watts and can be wound with any resistance up to 1,500 ohms. Resistance lamps have been used in many laboratories and telegraph exchanges in the past, but have the disadvantage that the resistance alters and ages and that they occupy considerable space and are costly. This tube is of the standard Ward Leonard type, and the wire has a zero temperature coefficient and is protected from electrical, chemical and mechanical depreciation. Any size Ward Leonard tube up to 200 watts capacity can be mounted in this manner.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 184 Lake Street, Chicago, announces a new type of rheostat, giving ten to fifty times as many steps as in the ordinary rheostat, thus securing close control of the current. The instrument is compact, durable and neat, and the manufacturers believe this to be the ideal rheostat for the laboratory, and for all classes of work where fine control is an essential feature. The same company also makes speed regulators, field rheostats, battery-charging rheostats, moving-picture-machine rheostats, theater dimmers, etc.

MANNING, MAXWELL & MOORE, 85 Liberty Street, New York, N. Y., are distributing their new tool catalogue. This gives a thorough presentation of modern machine tools designed for service with high-speed steel and with the latest devices in motor drives. The tools illustrated and described are grouped carefully for convenient investigation. Great care and expense have been given to the production of this catalogue, the quality of paper, the arrangement of detail, and the execution making it a very valuable addition to literature of this subject. For the convenience of those using the book, a careful codification of all types of machine tools and appliances illustrated has been made. The catalogue contains 1,775 pages of information regarding the latest designs of machine tools now on the market.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 10, 1908.

903,164. ELECTROLYTIC APPARATUS. Paul Borgnet, Liege, Belgium. Filed May 11, 1907. The cathode is arranged to float unsupported in the bath and the anode is arranged in proximity to the cathode.

903,165. THERMOSTATIC CIRCUIT-CONTROLLER. George H. Bowen, Boston, Mass. Filed June 20, 1907. A glass tube encloses a movable member and sustains its fusible support.

903,177 and 903,178. SYSTEM FOR CONTROLLING ONE OR MORE ELECTRIC MOTORS. Henry H. Cutler, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed August 11, 1905. In a multiple-unit train-control system there are electromagnetic switches on each car responsive to different voltages.

903,193. SYSTEM OF CONTROL. Ray P. Jackson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed May 8, 1905. Renewed January 20, 1906. A traction motor-control system has a master controlling switch and a switch operated by the motor, both connected to the transformer winding.

903,195. TESTING-GALVANOMETER. Harry T. Johnson, New York, N. Y., and Charles E. Avery, Jersey City, N. J. Filed March 22, 1906. A flat magnet core is disposed in a horizontal central position relatively to the needle and has a greater width at its center than at its ends.

903,197. TELEPHONE-TRANSMITTER. William Kaisling, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill. Filed March 15, 1906. The transmitter comprises a plane diaphragm fixed at its center, a granule chamber mounted thereon, co-operating electrodes within the chamber and a body of granular carbon between the electrodes.

903,198. PRODUCING PHONOGRAPHIC RECORDS. Isidor Kitsee, Philadelphia, Pa. Filed March 6, 1908. The method consists in first recording the sound waves upon a suitable surface and electroplating upon the parts of the surface upon which no record has been made.

903,199 and 903,200. PHONOGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed March 12 and June 11, 1908. These are modifications of No. 903,198.

903,203. POUSSE-CAFE MACHINE. John Krivanek, San Francisco, Cal. Filed October 29, 1907. A series of chambers is equipped with valves and electrically controlled mechanism by which the valves are actuated to successively deliver a liquid from each of the chambers into a glass.

903,213. FLUID-GAGE. Morris Martin, Boston, Mass. Filed April 13, 1907. A removable carrier is provided with a magnetic needle and a device normally operative to lock the needle, combined with a gage head having a stud and a movable magnet.

903,221. OUTLET-BOX COVER. George B. McBean, Chicago, Ill., assignor to Mechanical and Electrical Manufacturing Company, Chicago, Ill. Filed February 23, 1907. Comprises a non-conducting socket and an annular metallic cover embracing the socket.

903,251. CIRCUIT-CLOSING DEVICE. Alfred A. White, Bangor, Me., assignor to National Trade Tapper Company, Bangor, Me. Filed May 18, 1907. Consists of a clock mechanism with a segment wheel and a contact member adapted to intermittently contact therewith.

903,257. CONTACT-OILER. Albert D. Wiswall, Utica, N. Y. Filed June 12, 1907. Renewed April 8, 1908. Combined with a controller having a rotatable shaft with contact plates thereon and fingers engaged by the plates, is a rotatable roll of lubricant-saturated material in engagement with the plates.

903,287. PROCESS OF THE MANUFACTURE OF INSULATING MATERIALS. Hermann v. d. Heide, Datteln, Germany, assignor to The Firm of Wunner'sche Bitumenwerke G. M. B. H., Datteln, Germany. Filed May 31, 1907. Consists in mixing pitch and heavy coal tar oils, emulsifying this mixture with a solution of alkaline reaction and water-glass, and oxidizing the emulsion with superoxide of barium.

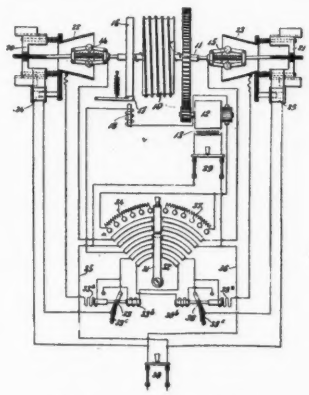
903,288. MOTOR-CONTROLLING SYSTEM. Clark T. Henderson, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed March 14, 1907. There are means for maintaining the main switch closed upon the stopping of the motor until the field resistance device removes all the resistance from the field circuit.

903,316. INSULATING COVERING FOR PIPES. Alois Reimann, Zizkov-Prague, Austria-Hungary. Filed July 22, 1908. A cord coated with water-glass is coiled around the pipe, spun glass filling the spaces between the cord coils.

903,319. THERMOSTAT FOR ELECTRIC HEATERS. Earl H. Richardson, Ontario, Cal., assignor to Pacific Electric Heating Company, Ontario, Cal. Filed January 2, 1908. A heat-controlled cut-out for an electric flat iron.

903,331. TYPE-CASTING AND COMPOSING MACHINE. Oddur V. Sigurdsson, New York, N. Y., assignor to Oddur Manufacturing Company, New York, N. Y. Filed June 25, 1906. A number of type-casting units are provided with an electromagnetic starting device for each unit and a set of operating keys, any of which when manipulated is adapted to complete the circuit.

903,338. CONTROLLER CONSTRUCTION. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed March 31, 1906. Construction of the blow-out magnet for a drum-type controller is described.

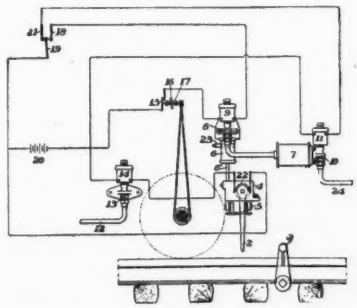


903,348.—CONTROLLER.

903,348. CONTROLLING APPARATUS. Albert G. Wessling, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed December 9, 1907. There are means for interrupting the supply of power to a hoisting motor when the latter is approaching a predetermined stopping point.

903,359. AUTOMATIC CONTROL FOR RAILWAY TRAINS. John P. Coleman, New York, N. Y., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed November 6, 1907. An electromagnet controls the air-brake valve and is itself controlled by the speed of the train.

903,366. TROLLEY POLE. Seybert D. Fenimore, Folcroft, Pa. Filed December 4, 1907. The pole has upper and lower sections connected by a knuckle joint.



903,413.—SPEED CONTROL OF TRAINS.

903,383. ELECTRODE FOR ARC LAMPS. Franz Janecek, Karlin, near Prague, Austria-Hungary. Filed May 16, 1907. Consists of a rod provided with a longitudinal dovetailed groove and a ladder-shaped metal strip located and held in the groove by its own resiliency.

903,401. ELECTRIC-LAMP SHADE HOLDER. Franklin Overbagh, Evanston, Frank E. Ayers, Hinsdale, and Irvin H. Brent, Chicago, Ill., assignors to Overbagh & Ayres Manufacturing Company, Chicago, Ill. Filed April 20, 1908. A flat annular sheet-metal body is provided with a number of projections which constitute a series of resilient prongs provided with studs spirally arranged and engaging a clamping ring.

903,404. METHOD OF SEPARATING ELECTRO-DEPOSITED METALS FROM LEAD MATRICES. Charles Reverdys, New York, N. Y., assignor to F. Wesel Manufacturing Company, Brooklyn, N. Y. Filed October 25, 1907. Consists in treating the surface of a lead matrix with a blast of carbon dioxide previous to producing the electro-deposit thereon.

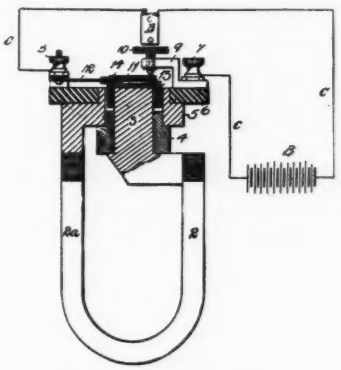
903,410 to 903,413, inclusive. APPARATUS FOR AUTOMATICALLY CONTROLLING THE SPEED OF TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 3, 1907. A trip device for actuating the brake-controlled valve is normally held in operative position and shifted therefrom by a motor. Means actuated by the speed of the train control the operation of the motor.

903,414 and 903,415. COMBINED SIGNAL AND SPEED-CONTROLLING MECHANISM FOR RAILWAY TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 3, 1907. A stop signal and caution signal have each a separate track stop and actuators shift the stops into and out of operative positions.

903,416 and 903,417. APPARATUS FOR AUTOMATICALLY CONTROLLING THE SPEED OF TRAINS. Jens G. Schreuder, Edgewood Park, Pa., and Vibe K. Spicer, Chicago, Ill., assignors to the Union Switch and Signal Company, Swissvale, Pa. Filed August 8, 1907. These are modifications of Nos. 903,410 to 903,413.

903,499. ELECTRIC-LIGHT STAND. Jefferson F. Pierce, Tampa, Fla. Filed May 11, 1908. The stand has a normally concealed coiled spring, the lower portion of which constitutes a clamping member.

903,508. ELECTRIC PICK MINING MACHINE. Alfred Sandstrom, Chicago, Ill., assignor to John F. Bush, Chicago, Ill. Filed April 1, 1904. Renewed April 7, 1908. An electromagnet holds a reciprocatory tool in retracted position and a motor produces sufficient air pressure to release the tool from control of the magnet and to thrust it forward.



903,745.—INTERRUPTER.

903,547. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed June 29, 1903. Relates to signaling means for a common-battery system.

903,552. LIFTING MAGNET. Arthur C. Eastwood and Frederick R. Fishback, Cleveland, Ohio, assignors to the Electric Controller and Supply Company, Cleveland, Ohio. Filed April 4, 1908. The magnet has a winding of low resistance adapted for operation in series with an electric hoisting motor.

903,561. TELEPHONE SYSTEM. Joseph A. Geller and Stephen H. Geller, Chicago, Ill. Filed November 4, 1907. This patent covers a selective controlling mechanism for the signaling and receiving circuits.

903,568. ELECTRICAL CONTACT-MAKER. John H. Hart, Memphis, Tenn. Filed January 20, 1908. A lever is yieldingly suspended across the path of a wire.

903,577. ELECTRIC FLOOR PUSH-BUTTON. Henry F. Keil, Bronxville, N. Y. Filed March 3, 1908. Consists of a face plate, a plunger, two spring fingers and an insulating body to support the same.

903,580. ELECTRIC-CURRENT REGULATOR. David R. Knapp, Philadelphia, and Howard E. Cade, Pencoyd, Pa. Filed May 29, 1907. A regulator for a storage battery charging system.

903,592. POWER GENERATOR. Charles J. Low, Chelan, Wash. Filed January 3, 1907. A wheel is mounted on the shaft in front of the boat and drives an electric generator that supplies current to the propelling motor.

903,640. ELECTROMEDICAL APPARATUS. Reinhold H. Wappler, New York, N. Y., assignor to Wappler Electric Controller Company, New York, N. Y. Filed December 30, 1907. Comprises a coil, an interrupter disc, and means for simultaneously rotating the disc-actuating means for taking a sinusoidal shunt current from the coil.

903,653. GEARING. Arthur V. Allen, Chicago, Ill. Filed April 6, 1907. On top of the field frame of a motor is mounted a bracket for an adjustable friction gearing.

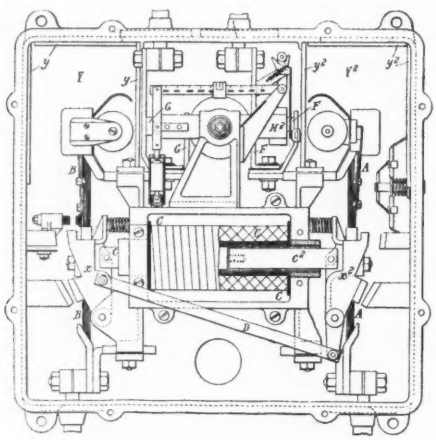
903,689. AIR AND GAS ENGINE. Hugh T. Dunn, New York, N. Y., assignor of one-half to Benjamin A. Jackson, New York, N. Y. Original application filed January 22, 1902. Divided and this application filed April 28, 1903. A pin mounted in a reciprocating arm makes contact between two stationary electrodes in the cylinder.

903,692. FEEDER-WIRE INSULATOR. George M. Finckel, Columbus, Ohio, assignor to the Sackett Mine Supply Company, Columbus, Ohio. Filed May 20, 1908. The insulator body has a through opening provided with a keyway.

903,968. TROLLEY WHEEL. Edmund J. Fredericks and Dilla R. Fredericks, Ohio, Ill., assignors to Lucien F. Hutchens, Minnie Remsburg and Dora Chase, Conneaut, Ohio. Filed September 27, 1907. A harp with oil chambers formed therein carries a hollow axle having apertures so that the oil chambers communicate with the axle and conduct the oil to the wheel.

903,705. ROTARY SNAP-SWITCH. Gilbert W. Goodridge and George B. Thomas, Bridgeport, Conn., assignors to the Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed January 3, 1908. The switch piece consists of a central blade with contact ends, top and bottom plates, and intermediate insulating sheets, the top plate having arms and an indicating dial clamped thereon.

903,733. TELEPHONE BRACKET. Benjamin M. Lampert, Cedar Bluffs, Neb. Filed June 10, 1908. Depression of a pedal opens the lazy-tong suspension for a desk telephone.



903,791.—DOUBLE-POLE CIRCUIT BREAKER.

903,745. INTERRUPTER. Carl E. Pearson, Lansing, Mich., assignor to Charles H. Bates and James H. Wellings, Lansing, Mich. Filed July 10, 1907. A make-and-break apparatus is provided with a tongue adapted to make connections with a contact point, a conductor being secured to the tongue and located in a permanent magnetic field.

903,752. PROCESS OF FORMING PLATES FOR STORAGE BATTERIES. William Morrison, Chicago, Ill., assignor to George Rumrill Coryell, Chicago, Ill. Filed December 26, 1902. Consists in subjecting the lead plates to electrochemical action in a solution formed by a mixture of sulphuric and nitric acids and permanganate of potash.

903,768. SIGN RECEPTACLE. Clarence D. Platt, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Filed December 12, 1907. A lamp receptacle has a body and a ring to attach it to the sign plate in combination with means to lock the receptacles to the sign plate in a number of positions.

903,785. SIGNAL SYSTEM. John J. Ruddick, Newton, Mass., assignor to United States Electric Signal Company, Portland, Me. Filed May 23, 1908. A block system consists of a normally closed circuit throughout the block and means for sending a signaling current by opening this circuit and connecting one point thereof to the source of current and another point to ground.

903,791. DOUBLE-POLE ELECTRIC CIRCUIT-BREAKER. William H. Scott, Norwich, England. Filed July 24, 1908. The sparking points of the switches are arranged in separate compartments so that flashing over from one to another is prevented.

903,796. ELECTRIC BLOCK-SIGNAL SYSTEM. Paul J. Simmen, Oakland, Cal. Filed January 28, 1907. Sections of one rail of the track are connected only by inductive resistances to permit the passage of direct current and prevent the passage of alternating current.

903,799. STORAGE BATTERY. John L. Smith and Malcon O. Smith, Cleveland, Ohio. Filed July 20, 1908. The edges of the plates are carried by elastic non-conducting frames and a mud guard frame of non-elastic material is clamped between the plate-holding frames.

903,807. ADJUSTABLE SUPPORT FOR ELECTRIC WIRES. Albert W. Bensley, Pawtucket, R. I. Filed September 15, 1908. A support carries two insulators that can be adjusted to different angular positions.

903,811. RELAY FOR REINFORCING SOUND. Jens H. Christensen, Sövejen, Sölleröd, Denmark. Filed March 30, 1905. A telephone relay comprises a diaphragm, a pendulum adjacent thereto and having a contact bearing against it, the pendulum being supported by jewel bearings consisting of a mercury contact for conducting current through the pendulum.

903,812. ELECTRICAL PROTECTIVE APPARATUS. Frank B. Cook, Chicago, Ill. Filed March 8, 1906. A thermal protector for a telephone circuit has a number of conducting rods associated therewith.

903,813. CONTACTLESS THERMAL PROTECTOR. Frank B. Cook, Chicago, Ill. Original application filed July 28, 1905. Divided and this application filed April 12, 1907. This is a modification of the above.

REISSUE.

12,878. SUPPORT FOR POLE CROSS-ARMS. Edward C. Short, St. Paul, Minn., assignor to Steel Gain Manufacturing Company, Chicago, Ill. Filed June 13, 1906. Original No. 804,630, dated November 1, 1905. A curved post plate and a cross-arm plate with flanges are connected by tongues, and a bolt clamps the plates between the cross-arm and the post.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired November 17, 1908:

463,154. ELECTRIC ARC LAMP. William Jandus, Cleveland, Ohio.

463,174. ARMATURE FOR DYNAMOS OR ELECTRIC MOTORS. B. D. Southard, Chicago, Ill.

463,188. TELEPHONY. J. W. Gibboney, Lynn, Mass.

463,192. ELECTROMAGNETIC SWITCH. C. H. Herrick, Winchester, and W. M. Rand, Boston, Mass.

463,198. ELECTRIC STOP MECHANISM. L. Mellett, Somerville, Mass.

463,207. TELEPHONIC RELAY. E. E. Weaver, Philadelphia, Pa.

463,242. DYNAMO-ELECTRIC MACHINE. M. C. Burt, Chicago, Ill.

463,247 and 463,248. GALVANIC BATTERIES. W. A. Crowdus, Memphis, Tenn.

463,257. ICE-BREAKER AND ELECTRIC-CURRENT TRANSMITTER. C. Smith, Wilkesbarre, Pa.

463,297. ELECTRIC LOCK. F. H. Starrett, Clinton, Mich.

463,298. THERMO CIRCUIT CLOSER FOR ELECTRIC FIRE-ALARMS. J. Wrigley and G. Chambers, Paterson, N. J.

463,311. ELECTRIC SWITCH. E. J. Bagnall, St. Louis, Mo.

463,314. ALTERNATING OR PULSATING CURRENT MOTOR. L. Gutmann, Pittsburg, Pa.

463,315. POWER-STORING MECHANISM FOR ELECTRIC LOCOMOTIVES. J. A. Hochett, Stirling, Kan.

463,340. FIRE-ALARM TELEGRAPH REPEATER. G. M. Stevens, Cambridge, Mass.

463,356. ELECTRIC LOCOMOTIVE. S. H. Short, Cleveland, Ohio.

463,384. ELECTRIC CIGAR-LIGHTING APPARATUS. W. W. Foster, Boston, Mass.

463,395. ELECTRIC TRAIN SIGNAL. J. B. Strauss, Cincinnati, Ohio.

463,396. ELECTRIC SWITCH. A. Swan, Orange, N. J.

463,420. COUPLING FOR ELECTRIC WIRES. F. X. Gartland, Philadelphia, Pa.

463,428. TELEGRAPH SOUNDER. J. Maret, Mount Vernon, Ky.

463,486. PROCESS OF WELDING METALS ELECTRICALLY. C. L. Coffin, Detroit, Mich.

463,487. ELECTRIC WELDING OR WORKING OF METALS. C. L. Coffin, Detroit, Mich.

463,512. ELECTRICAL CONDUCTOR. P. H. Holmes, Gardiner, Me.

463,545. MULTIPLE SWITCHBOARD. F. A. Pickernell, Newark, N. J.

463,558. APPARATUS FOR MEASURING AND RECORDING ELECTRIC CURRENTS. William Thompson, Glasgow, Scotland.